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Isabel Maury
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From a Daguerreotype

Engd by I. S Ponderson

Yours truly

M. F. Maury

Lt. U. S. N.

Engraved for the Annual of Scientific Discovery 1855

Gould and Lincoln. Boston

ANNUAL

OF

SCIENTIFIC DISCOVERY:

OR,

YEAR-BOOK OF FACTS IN SCIENCE AND ART

FOR 1855.

EXHIBITING THE

MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS

IN

MECHANICS, USEFUL ARTS, NATURAL PHILOSOPHY, CHEMISTRY, ASTRONOMY, METEOROLOGY, ZOOLOGY, BOTANY, MINERALOGY, GEOLOGY, GEOGRAPHY, ANTIQUITIES, &c.

TOGETHER WITH

A LIST OF RECENT SCIENTIFIC PUBLICATIONS; A CLASSIFIED LIST OF PATENTS; OBITUARIES OF EMINENT SCIENTIFIC MEN; NOTES ON THE PROGRESS OF SCIENCE DURING THE YEAR 1854, ETC.

EDITED BY

DAVID A. WELLS, A. M.

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NOTES BY THE EDITOR

ON THE

PROGRESS OF SCIENCE DURING THE YEAR 1854.

The sixth annual meeting and eighth regular session of the American Association for the Promotion of Science was held in Washington, D. C., in the rooms of the Smithsonian Institution, during the week commencing with Wednesday, April 20, 1854. The President, elected at the Cleveland meeting, was Prof. Jas. D. Dana. The Association was divided into two sections—the physical and the chemical. The whole number of communications presented was 92: 37 in Physics and Astronomy; 12 in Meteorology; 25 in Geology and Mineralogy; 12 in Chemistry; 6 in Zoölogy.

Prof. Bache, from the Committee on the Constitution of the Association, reported a series of amendments, guarding more closely the admittance to membership,—making the President and General Secretary ineligible for reëlection,—requiring that local committees shall not arrange for excursions during the session before its opening,—enlarging the standing committees,—and prohibiting the recommendation of books, instruments, institutions, or processes. These and other amendments lie over until the next meeting, when they will be taken up for discussion, acceptance, or rejection.

The election of officers for the succeeding year resulted in the unanimous choice of the following:—For President, Prof. John Torrey, of New York; for General Secretary, Dr. Wolcott Gibbs, of New York; for Treasurer, Dr. A. L. Elwyn. The Permanent Secretary is Prof. Lovering, of Cambridge. The next meeting of the Association, by invitation of Brown University, will be held at Providence, R. I., on the third Wednesday of August, (the 15th,) 1855.

The twenty-fourth annual meeting of the British Association for the

Promotion of Science was held at Liverpool, commencing September 20, the Earl of Harrowby in the chair. The meeting at Hull, in 1853, was so thinly attended, and exhibited such a lack of interest on the part of the English savans, that the present meeting of the Association was looked upon by many as the crisis of its fortunes. Happily they have revived to a degree that promises well for the interests of science. The meeting at Liverpool was numerously attended, nearly all the distinguished promoters of science in Great Britain being present, together with a large number of foreigners of reputation. The Committee, in connection with the Royal Society, to whom was referred the plan of Lieut. Maury, of the National Observatory at Washington, for the improvement of navigation, reported that the English Government had established a department in the Board of Trade, with the view of carrying out in every particular the recommendations of the Royal Society and this Committee, in reference to this important scheme for improving navigation, and accumulating meteorological data to an extent far surpassing any thing which has hitherto been attempted. The Government have also appointed Capt. Robert Fitzroy, R. N., to be at the head of this new department, which is in itself a guaranty that it will successfully carry out all the important objects for which it has been established.

Scientific officers of the navy and mercantile marine will now feel assured that the records of their valuable observations and surveys will no longer slumber neglected amidst the dust of offices, but be reduced and rendered available to science and mankind without any unnecessary delay. The sum voted for the new department by the House of Commons for the present year is 3,200*l.*; but there can be no doubt that this sum will be augmented in future years, if the expectations that we have been led to form as to the inestimable public benefits likely to flow from the labors of this office shall be realized.

The "Kew Committee" reported that they had been especially engaged in securing accuracy for the various implements of observation—the thermometer, barometer, and the standard of weights and measures. At the present time they have intrusted to them, for verification and adjustment, one thousand thermometers and fifty barometers for the navy of the United States, as well as five hundred thermometers and sixty barometers for the English Board of Trade, the instruments which are supplied in ordinary commerce being found to be subject to error to an extraordinary degree.

The thermometer is constructed of enamelled tubing, and the divisions are etched on the stem with fluoric acid; the figures are stamped on the brass scale at every tenth degree, and each instrument is fitted to a japanned copper case, with a cup surrounding the bulb, and

has a distinguishing number. The cost, in consideration of the quantity ordered from the makers at one time, including the case, is 5*s*. 6*d*.; and without the case, 4*s*. 6*d*. for each thermometer. At the suggestion of Sir John Herschel, they have also undertaken, by the photographic process, to secure a daily record of the appearance of the sun's disk, with a view of ascertaining, by a comparison of the spots upon its surface, their places, size, and forms, whether any relation can be established between their variations and other phenomena. The Council of the Royal Society has supplied the funds, and the instrument is in course of completion. The same beautiful invention, which seems likely to promote the interests of science in many branches at least as much as those of art, is employed, under the able direction of the committee, and of Mr. Welsh, the curator, to record, by a self-acting process, something similar to that of the anemometer, the variations in the earth's magnetism.

From the address of the President we make the following extracts, as illustrative of the progress of science during the past year. In respect to the progress of astronomical science, the large number of planets and comets discovered of late years, while it evinces the diligence of astronomers, has, at the same time, brought additional laborers into the field of astronomical science, and contributed materially to its extension. The demand for observations created by these discoveries has been met by renewed activity in existing observatories, and has led to the establishment, by public or private means, of new observatories. For instance, an observatory was founded in the course of last year by a private individual at Olmütz, in Moravia, and is now actively at work on this class of observations. Various such instances have occurred within a few years.

"In addition to the advantages just stated, the observations called for by the discovery of new bodies of the Solar System have drawn attention to the state of *Stellar Astronomy*, and been the means of improving this fundamental part of the science. The following are a few words on the existing state of Stellar Astronomy, so far as regards *catalogues* of stars. Subsequently to the formation of the older catalogues of bright stars, astronomers turned their attention to observations in *zones*, or otherwise, of smaller stars, to the ninth magnitude inclusive. Lalande, Lacaille, Bessel, Argelander, and Lamont, are the chief laborers in this class of observations. But these observations, unreduced and uncatalogued, are comparatively of little value. The British Association did great service to astronomers by reducing into catalogues the observations of Lalande and Lacaille. A catalogue of part of Bessel's zones has been published at St. Petersburg, and a catalogue of part of Argelander's zones at Vienna.

Lamont's zones have also been reduced in part by himself. The catalogue of 8,377 stars, published by the British Association in 1845, is founded mainly on the older catalogues, but contains, also, stars to the seventh magnitude inclusive, observed once only by Lalande or Lacaille. The places of the stars in this catalogue are, consequently, not uniformly trustworthy; but as the authorities for the places are indicated, the astronomer is not misled by this circumstance.

"The above are the catalogues which are principally used in the observations of the small planets and of comets. This class of observations must generally be made by means of stars as fixed points of reference. The observer selects a star from a catalogue, either for the purpose of finding the moving body, or for comparing its position with that of the star; but from the imperfection of the catalogue, it sometimes happens that no star is found in the place indicated by it; and in most cases, unless the star's place has been determined by repeated meridian observations, it is not sufficiently accurate for final reference of the position of the planet or comet. In catalogues reduced from zone observations, the star's right ascension generally depends on a single transit across a single wire, and its declination on a single bisection. This being the case, astronomers have begun to feel the necessity of using the catalogue places of stars *provisionally*, in reducing their observations, and of obtaining afterwards accurate places by meridian observations.

"It will be seen by this statement that, by the observations of the small planets and of comets, materials are gradually accumulating for the formation of a more accurate and more extensive catalogue of stars than any hitherto published. The modern sources at present available for such a work are the reduced and published observations of the Greenwich, Pulkowa, Edinburgh, Oxford and Cambridge observatories, and the recently completed catalogue of 12,000 stars observed and reduced by the indefatigable astronomer of Hamburg, Mr. Charles Rumker, together with numerous incidental determinations of the places of comparison stars in the 'Astronomische Nachrichten.'

"To complete the present account of the state of Stellar Astronomy, mention should be made of two volumes recently published by Mr. Cooper, containing the approximate places arranged in order of Right Ascension of 30,186 stars from the 9th to the 12th magnitude, of which only a very small number had been previously observed. The observations were made with the Markree equatorial, and have been printed at the expense of Her Majesty's Government."

Some anxiety was felt by astronomers respecting the continuation of that most indispensable publication the *Astronomische Nachrichten*, after the decease of the editor, Mr. Petersen, in February last. This

has been dispelled by a recent announcement that the King of Denmark has resolved to maintain the Altona Observatory in connection with that of the editorship of this work.

Generally, it may be said of Astronomy, at the present time, that it is prosecuted zealously and extensively, active observations being now more numerous than ever, and that the interests of the science are promoted as well by private enterprise as by the aid of government.

In regard to the progress of the departments of geography and ethnography, Lord Harrowby remarks: "The great navigations which are opening up the heart of the South American continent, by the Paraguay, the Amazons, and the Orinoco; that are traversing and uniting the colonies of Victoria and South Australia by the River Murray; the projected exploration of North Australia; the wonderful discoveries in South Africa by Livingston and Anderson; and the explorations of Central Africa by Barth and Vogel; the pictures given us by Capt. Erskine and others of the condition of the islanders of the South Pacific, passing in every stage of transition from the lowest barbarism to a fitness for the highest European and Christian culture; these, and a hundred other topics, awaken an ever-new interest in the mind of the philosopher and statesman, in the feelings of the Christian and the lover of his kind. What new fields for science! What new opportunities for wealth and power! What new openings for good!

"It is happily becoming every year less and less necessary to press these things on public notice. In an age of gas and steam—of steam-engines and steamboats—of railroads and telegraphs, and photographs—the importance of science is no longer questioned. It is a truism—a commonplace. We are far from the foundation days of the Royal Society, when, in spite of the example of the monarch, their proceedings were the ridicule of the court; and even the immortal Butler thought the labors of a Wallis, a Sydenham, a Harvey, a Hooke, or a Newton, fit subjects for his wit."

The noble lord glanced cheeringly at the increasing facilities for education in science which are being opened up in this country. "The encouragements and assistance already given (he said) by the State to the education of the people in various shapes; the superior class of trained and examined teachers who are spreading over the land, and whose training has in no small degree been in physical science; the books provided for early education by our societies and by individual enterprise, having the same character; the every-day more and more acknowledged connection between agriculture and science, showing itself in such papers as enrich the pages of the journals of the Royal Agricultural Society; the establishment of the department of science with its school of mines under the Board of Trade; the improvement

which is to be expected under the action of the charity commissioners in the system of our old grammar schools; the spontaneous action of our old universities, not superseded, but facilitated and stimulated, by parliamentary interposition; these and such like changes which are taking place, partly within the bosom of society itself, and partly by the action of government, will shortly provide such means of scientific education, although not systematized with the exactness of continental organization, as will, after our rough English fashion, adequately provide for all our wants in that respect, and give us no cause to lament over any deficiencies in practical results.

"But will there be encouragement to make use of these facilities? Are there rewards in prospect, whether of direct emolument or social consideration, which will induce men 'to wear out nights, and live laborious days,' in a service which has hitherto, in the world's eye at least, appeared often to be ill requited? Now, the real stimulant to science has at all times been the delights of the pursuit itself, and the consciousness of the great services rendered to humanity by every conquest within the domain of truth; but still these questions may fairly demand an answer. To the questions of pecuniary rewards, I will presently advert. They have certainly been miserably inadequate; but in regard to social considerations, I think there has existed some misunderstanding. It has been often asserted, and made the subject of lamentation or complaint, that men of science do not enjoy in this free country the consideration which they do in some countries less favored otherwise in their institutions than ourselves. Now, if by this it is intended to express that men of science are not made Knights of the Garter or peers of parliament; that they are not often met with in the hearts of wealth and fashion; that they are not called into the councils of their sovereign, or sent to represent her in foreign courts, I admit the fact; but, then, I doubt whether these are the natural or fitting objects of ambition to the scientific man: and if it is intended by the assertion that they are not, as a class or individuals, appreciated by their fellow-citizens for their genius and honored for their services, I cannot so fully admit the fact. I would ask any of those whose presence adorns this meeting, Do they not find that their names are a passport into any society, the proudest in the land? Whose doors that are worth entering are not open to them? There are certain advantages, superficially considered, which will always belong to mere wealth or power; but are they such as the lover of science can bring himself to envy or desire? Wherever he is known, he is honored.

"Still, however, in regard to science, I must admit that there is one great deficiency. For often may it be said of science, as it was said satirically of virtue by the poet, *Laudatur et alget*,—It is praised and

starves. The man of science may not desire to live luxuriously; he may not, nor ought he, desire to rival his neighbors in the follies of equipage and ostentation, which are often, indeed, rather a burden imposed by the customs of society than an advantage or even a gratification to the parties themselves; but he must live, and for the sake of science itself he ought to be able to live, free from those anxious cares for the present and the future, or from the calls of a profession, which often beset and burden his laborious career. Why was our Dalton compelled to waste the powers of such an intellect on private teaching? As a teacher, a physician, or a clergyman, or more rarely as a partner in a profitable patent, such a man may earn a competence, and give to science the hours which can be spared from his other avocations; and it is, indeed, astonishing what results have been the produce of these leavings of a laborious life, these leisure hours, if so they may be called, of men who are engaged in arduous duties of another kind. But this ought not to be; and it will not long be, I am confident. It must give way before the extended cultivation of science itself. The means of occupation, in connection with our schools, and our colleges, and our examinations, will increase; and I cannot but hope that a grateful country will insist upon her benefactors in science receiving a more liberal share of her bounty than has hitherto been allotted them. Nor have I any fear that the study of science should ever become too exclusive,—that is, should make us too material,—that it should overgrow and smother those more ethical, more elevating, influences which are supposed to grow from the pursuit of literature and art.

"In the first place, the demands of science upon the patient and laborious exercise of thought are too heavy, too severe, to make it likely that it should ever become the favorite study of the many. In art and literature the mind of the student is often comparatively passive, in a state of almost passive enjoyment of the banquet prepared for him by others; in those of science the student must work hard for his intellectual fare. He cannot throw up his oars,

> 'And let his little bark attendant sail,
> Pursue the triumph, and partake the gale;'

but he must tug at the oar himself, and take his full share in the labor by which his progress is to be made.

"Nor indeed, when I read the works of a Whewell, and a Herschel, and a Brewster, a Hugh Miller, or a Sedgwick, and a hundred others, the glory of our days, can I see any reason for apprehending that the study of science deprives the mind of imagination, the style of grace and beauty, or the character of its moral and religious tone, its elevation and refinement."

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It was voted to hold the next meeting of the Association at Glasgow, Scotland, the Duke of Argyle being elected President for the ensuing year, and Col. Sabine Secretary.

The whole number of papers presented at this meeting was 280. Of these, 58 were upon subjects connected with mathematical and physical science, 43 upon chemical science; 34 treated of geology, 41 of zoölogy and botany, including physiology, 35 of geography and ethnology, 24 of statistics, and 44 of subjects in relation to mathematical science.

The meeting of the Association was closed with a grand dinner, given by the Earl of Harrowby, the President, to the members and friends of the Association. Sir R. Murchison discharged the duties of chairman, and nearly 800 ladies and gentlemen were present. The dinner was succeeded by a brilliant *soirée* at the Town Hall, given by the Mayor to the members of the Association and the *élite* of Liverpool and the neighborhood.

The thirty-first meeting of the Society of German Naturalists and Physicians was held at Göttingen, September 18, under the Presidency of Prof. Baum. The meeting was well attended, most of the distinguished scientific men of Germany being present. After the formal opening of the session, and a few remarks by the President, Prof. Wagner, (Hofrath,) of Göttingen, read, according to usual practice, a scientific address. The subject he had chosen was "On certain Portions and Modes of Considerations of Anthropology." A better title, he observed, would perhaps have been, "On the Creation of Man and the Substance of the Soul." The main objects of his address were, 1st, the praise of Blumenbach; and 2d, a polemical attack on the anthropological views of a modern author whom he did not name, but who is supposed to be Carl Vogt, whose doctrines he denounced as immoral and derogatory of human nature. After explaining Blumenbach's doctrine of the five races, which showed no greater differences than the local and geographical varieties of the same species in many of our domestic animals, and which had been confirmed by modern science, he stated that these views were still further strengthened by the result of recent linguistic investigations. Then comes the question, Are all men of one race, and are all descended from one pair? Notwithstanding partial assertions to the contrary, the result of his scientific investigations had convinced him that no argument could be drawn from the study of the natural history part of the question against the existence of only one species; and, moreover, although it was difficult to adduce any direct proof for or against the descent from one single pair, he was equally convinced that there was no argument against such a view. He then

proceeded to discuss the other portion of his theme, and to consider whether modern science, either as natural history or physiology, had made any progress respecting the future life, or with regard to the state and nature of the soul. Materialism in this respect had made great progress in latter times; and he vehemently attacked the views of a modern author, who, amongst other things, asserted, that to assume a spiritual soul dwelling in the brain, and thence directing the motions and actions of the body, was the greatest absurdity, and who had also denied the truth of such a thing as individual immortality. Were the views of this author, who also denied the existence of free will, founded in truth, or even recognized as such, where would be the use of all the exertions of those great, and good, and learned men who for centuries have labored and worked for the improvement and instruction of the human race? There would be nothing great or noble in man's nature; there would be no reality in history, no truth in faith. Where would be the result of all our scientific investigations? He concluded by observing that, however difficult or even impossible it might be to explain the nature of the soul, we must be satisfied that the answer could not be one which was opposed to all morality and all virtue.

At the German Scientific Association, held at Tubingen, in 1853, in Wurtemberg, Prof. Karnat stated that Germany possesses coal sufficient to supply the whole world with fuel for at least 500 years. At the same Congress it was reported that a number of perfect human skulls with teeth in them had been found in the Suabian Alps in the formation of the mammoth period, which leads to the conclusion that man existed at the time when the mastodon and other of the huger antediluvian animals flourished.

At the late meeting of the British Association at Liverpool, the Ray Society held its eleventh anniversary, Sir Charles Lyell in the chair. The report stated that a volume of Botanical and Physiological Memoirs, including Alexander Braun's profound treatise on "Rejuvenescence in Nature," had just been published. The following works were on the table, and ready for distribution:—Part VI. of Alder and Hancock's "Nudibranchiate Mollusca," for 1851; the second volume of Darwin's great work on "The Cirripedes," with thirty plates, for 1852; and the fourth volume of the "Geological and Zoölogical Bibliography," for 1854. It is the intention of the Council to publish a supplement and index to the last work.

During the past season an Educational Exhibition has been held in London for the purpose of illustrating the condition of Elementary Education in the United Kingdom and its Colonies, Continental Europe, and the United States of America, by bringing together com-

plete collections of educational appliances and objects, such as, 1st. Models of school buildings, arrangements and fittings, Books, Maps, Diagrams, Models, Apparatus, &c.; 2d. Specimens of the work done in schools; viz., Drawings, Writings, Needlework, &c.; 3rd. Laws of Public Instruction, Statistics of Education, School Regulations, Time Tables, &c.

The exhibition opened in June, and continued for about three months. It was entirely successful, and its results cannot fail of benefiting the cause which it illustrated. Among the articles exhibited were choice specimens of fishes, crustacea, marine plants and vegetable productions used in commerce, such as seeds, roots, fibres, &c.; models of school-houses, copy-books, school clocks, globes, stationery, drawing and coloring materials, diagrams, prints, maps, hydrostatical and pneumatical apparatus, Attwood's machine for illustrating the laws of falling bodies, the geometrical solids, a machine for illustrating centrifugal force, sets of the mechanical powers, sectional models of steam-engines, &c. Also, contributions of the asylums for the blind, the deaf and dumb, and idiots, and specimens of workmanship executed by pupils of the Ragged Schools. The East India Company exhibited a very interesting collection of articles—comprising, among other things, specimens of pottery, made at the Madras School of Arts and Industry, cordage made of plantain and agave fibre, with various models, &c.

America, especially the United States, was largelv represented with various contributions, illustrating the progress of the common schools within the last few years.

A society has recently been formed in England, under the title of "The Palestine Archæological Association," having for its object the exploring of the ancient and modern cities and towns, or other places of historical importance, in Palestine and the adjacent countries, with a view to the discovery of monuments and objects of antiquity, by means of researches on the spot. The prospectus runs as follows:—"Archæological Research in the East having now attained such important results, in the discovery and acquisition of splendid monuments, both Egyptian and Assyrian, and a great archæological chain of inquiry having been thus established from Egyptian Thebes to the site of Nineveh, it has been suggested that Palestine presents itself the middle link in this chain, as being full of rich promise to researches and inquiries of a similar character. If Egypt and Assyria have afforded so many valuable monuments to the truth of history and tradition, it may reasonably be expected that Palestine would yield as rich a harvest. Why should not the sites of the ancient cities and towns of the Hebrews, and of the aboriginal inhabitants of Canaan, be

explored? And why might not the localities of important monuments—especially of the Hebrews—be sought for, under the guidance of scriptural authority and of tradition—as, for instance, the Egyptian coffins of the patriarchs at Hebron and Sychem; the twelve stones set up by Joshua at Gilgal and in the Jordan; the monumental record of the Law in the Stone of Sychem; the sacred Ark, supposed to have been concealed by the prophet Jeremiah in some recess; with many others which will suggest themselves to the biblical reader? The discovery, if not also the recovery, of these precious relics of Hebrew antiquity might be accompanied or followed by the acquisition of various objects of historical importance, as coins, vessels, implements, sculpture, inscriptions, manuscripts, and other documents, all illustrative of the most interesting periods of remotest antiquity; and that in the Holy Land, the land of the Bible, such a treasure of archæological knowledge would possess a high degree of importance, as corroborative of the Sacred Writings, and would doubtless be so esteemed, as well by the learned as by the religious world."

At a recent meeting of this Society, an address was given by Dr. Turnbull, in which he stated that the idea of this Society was not borrowed from any recent movements of a similar nature, much less intended to rival them, but arose simply from the perusal of the Books of "Genesis, Exodus and Joshua," and more especially from the circumstance recorded of the embalming and burying of the patriarch Jacob, at Hebron, by his son Joseph, Viceroy of Egypt; that the coffin is in all probability remaining entire in the Cave of Machpelah, as then deposited; and that there can be little doubt, if examination, with all proper attention to decorum, were permitted, we should find on the exterior, and within the coffin, some characters, and, perhaps, some emblems, not according to the idolatrous mythology of Egypt, but relating to Jacob and his family and ancestry, and perhaps, also, relative to the countries of Egypt and Palestine.

In reference to the coffins of the Hebrew patriarchs, he had formed expectations of the most important discoveries. In that of Joseph he did not see why we might not find a papyrus, containing his own autobiography, together with other great historical documents, such as have been found on opening tombs in Egypt. Who would have imagined that we should have found some of the rarest works of the Greek classics in the tombs of Upper Egypt? Yet some of these we have seen in lithographs of the papyri, as recently produced at a meeting of the Syro-Egyptian Society.

The London Society of Arts have appointed a Committee of Industrial Pathology for the purpose of inquiring into the nature of accidents, injuries, and diseases incident to various bodily employments,

and of suggesting means for their prevention or relief. It is proposed to select each year, for special and thorough investigation, a single trade, or group of trades, or some particular kind of injury. Thus it is contemplated to devote the remainder of the present session to as complete an inquiry as the means at the disposal of the Committee may permit into the injury to the eyes which unfortunately attaches to many industrial occupations, and a synopsis of some of the physical evils which attach to various kinds of industrial labor is to be circulated among artisans and others for information. It is then proposed to hold in the ensuing sessions an exhibition of inventions and appliances for making such handicraft employment more healthy.

The London Geographical Society has received advices from the travellers sent out under its auspices: Lieut. Burton and Dr. Wallin are pushing their way in Arabia; and Dr. Vogel, when last heard from, was on the borders of Lake Tchad, which he describes as more resembling a vast marsh than a sheet of water. The interior of Africa, he says, is a "terrible country" to travel in. Were it not for the importance of clearing up its geography and discovering its resources, few would be found to explore it.

Among the various results of Dr. Vogel's scientific labors transmitted to England, his astronomical observations to fix the position of Kuka are of the highest importance; for when the three coördinates—latitude, longitude, and elevation—of this great central point of Africa have been determined with definite exactitude, we possess a beacon by which all other researches respecting Central Africa which have been collected up to the present time, and the various journeys and itineraries which have been performed in that region, will be rectified and fixed upon the map. Dr. Vogel is the first professional astronomer of acknowledged talent who has undertaken a journey to Central Africa; and so little reliance was placed on the observations of his predecessors,—even so justly celebrated travellers as Clapperton and Denham,—by writers on African geography, that every one seems to have considered himself perfectly justified in improving upon them and shifting them about *ad libitum*, hundreds of miles, to the east or west.

The result of Dr. Overweg's astronomical observations of Lake Tsad, backed by the opinion of Prof. Encke, clearly indicated that Clapperton and Denham's position was too far to the east, but left the precise distance undetermined. It was reserved for Dr. Vogel to solve this *vexata quæstio*, which, for one of his age, (22 years,) is no small merit. According to him, the position of Kuka is as follows:—12° 55′ 14″ latitude N., 13° 22′ longitude E., from Greenwich. Elevation above the level of the sea, 900 feet—50 feet above Lake

Tsad. This is a fact of no little importance, as such a height allows no fall for any of its rivers, if connected, according to some writers, with the Nile, or the Kowara, or Niger.

Respecting the botanical features of the country, Dr. Vogel was surprised to find, among other plants, the *Ficus elastica*, the tree that furnishes the caoutchouc, inasmuch as it was not noticed by any previous traveller. It grows in considerable quantities in Bornu; but the inhabitants are not acquainted with the nature and use of the product it bears.

It is known that M. Andersson, a young Swedish naturalist and traveller, is making explorations in Central Africa. Letters just received from him, *via* the Cape of Good Hope, announce that he had succeeded in reaching the great Lake of Nigami. He is the first European who has penetrated so far from the western coast.

Special reports by Sir Charles Lyell have appeared on the Geological and Topographical and Hydrographical departments of the New York Exhibition, which are highly valuable and interesting for the summary they present of what the United States contain and are capable of in those important subjects. The facts adduced in matters geological, owing to the vast extent of country, are truly amazing, and the sources inexhaustible.

After passing the whole subject in review, Sir Charles concludes by stating that "the natural distribution of these sources of wealth and power, combined with the physical features of the entire country, leave nothing to be desired with respect to the materials and incentives for its physical progress and development." "If in a pecuniary sense," says the editor of Chambers's Journal, "the American Exhibition was a failure, the loss has been largely compensated by the interesting reports it has called into existence."

The following are among the prizes offered by the French Academy during the past year:—

For the year 1856.—A vigorous and methodical investigation into the metamorphoses and reproduction of the Infusoria, properly so called, (the Polygastrica of Ehrenberg.)

2d. For 1855.—An exposition of the laws governing the distribution of fossils in the different sedimentary strata in their order of superposition; and a discussion of the question of their appearance or disappearance, successive or simultaneous.

A research into the nature of the relations existing between the present and past states of the organic kingdom.

Another for 1856.—The determination through the study of the development of the embryo in two species, one taken from the class

of vertebrata, and the other either from the Mollucca or Articulata, of the proper foundation for comparative embryology.

The prizes for either of the above is a gold medal of 3,000 francs.

A medal of gold, of the value of 800 francs, is decreed each to the work, printed or in manuscript, which appears to have contributed most to the progress of *Experimental Physiology.* A gold medal of the value of 2,500 francs is offered, for 1856, for the best work on the *mode of fecundation* of eggs, and the structure of the organs of generation, in the principal natural groups of the class of Polyps, or that of Acalephs.

The sum of £4,000 has recently been bequeathed to the French Institute, to be given to the discoverer of a cure for the Asiatic cholera, the annual interest of the sum to be awarded to those who may do most to relieve the terrible malady.

The Royal Scottish Society of Arts offers prizes, varying from £10 to £30, for "any thing new in the art of clock or watch making," for inventions or new appliances in the useful arts generally, and for "means by which the natural productions of the country may be made more available." And the Scientific Society of Leipsic announces prizes for papers on commerce, astronomy, and political economy, to be written in French, German or Latin. The Royal Academy of Berlin offers two hundred ducats to whomsoever shall furnish a satisfactory reply to certain inquiries touching the well being of a State. It wishes to know, among others, whether Adam Smith's leading doctrine — work makes wealth — can be identified with the prosperity of a people. The Royal Institution of Great Britain makes known that the Actonian prize of £105 will be ready in 1858 for the author of the best essay on the "Wisdom and Beneficence of the Almighty, as manifested by the Influence of Solar Radiation." So much knowledge has been gained of this subject within the past few years that materials are abundant, and we ought to have an essay of more than ordinary interest.

The "Société Médico-Pratique de Paris" offers a prize, in the form of a gold medal worth three hundred francs, for the best dissertation on the mode of action of the principal purgatives used in medicine, with the special indications for their use.

The curious effects attributed to the extract and various other preparations of the Canabus Indicus, as used in Egypt, has induced the above Society to offer a prize of one thousand francs for the best analysis of the *cannabis.*

The Society of Arts, London, offers a premium of fifty guineas to any person who will furnish them with modes of operation, models, and specifications of machinery by which the New Zealand flax,

Phormium Tenax, may be dressed at a cost not exceeding £5 per ton, (this price to prepare the flax as a raw material,) reckoning the wages of an ordinary laborer at 4s. per diem, and of artisans at 6s. to 6s. 6d. The machine to be of two kinds — one analogous to the old spinning-wheel, that may be used in every cottage or shepherd's hut, and the other suitable for more extensive operations.

The New York Academy of Medicine, through the liberality of a few of its members, offers a prize of $100 for the best essay on "The Nature and Treatment of Cholera Infantum," to be presented during the ensuing year. The trial for the prize is open to the profession throughout the country.

The National Education Society, at its session at Pittsburg last August, offered a reward of $500 for the best philosophical work on education. That Society adjourned to Washington city, August 8, 1854.

The French Government has decided that a periodical, containing reports and papers of scientific and literary societies, accounts of missions, &c., shall henceforth be published under the title of *Bulletin des Sociétés Savants.*

At the last meeting of the Royal Geographical Society the Founder's medal was presented to Admiral Smyth, for his able and all but exhaustive work on the Mediterranean Sea. A medal was also presented to Capt. McClure for his discoveries in the Polar Regions.

The office of superintendent of the French National Observatory has been given to M. Leverrier.

A petition, drawn up by M. Vattemare, has been addressed to the American Senate. Its purpose is to induce that body to examine the French metrical decimal system for weights and measures, and adopt it, or a similar one, in the United States. In France the monetary system is decimal, and has been since the revolution of '93; the thermometer is decimal, since Napoleon established the centigrade; and measures of length, surface, solidity, capacity and weight, have been obligatory decimal since 1840.

At the recent Congress of the learned societies of France, the subject of the acclimatization of useful plants and animals received considerable attention. It was stated that, from what has already been done and what is now doing, there is every reason to expect that several sorts of vegetables, fruits, plants, birds, fish, and animals heretofore confined to Asiatic or American countries, will before long become completely naturalized in France, and will in time form an important part of the people's food, or will add to the conveniences or pleasures of life.

A new tuber, the Chinese Yam, has been introduced in Paris, from

China, which experimentists say possesses all the requirements of the potato, and may take the place of that plant as a culinary vegetable. Specimens have also been introduced in England, where they thrive well. It has been domesticated and is perfectly hardy in Paris. Its root is bulky, rich in nutritive matter, eatable when raw, easily cooked either by boiling or roasting, and then having no other taste than that of flour.

An attempt is about to be made to introduce the Angora goat into Cape Colony, South Africa, an enterprise which promises great success.

A new species of silkworm, from Assam, Southern Asia, has been introduced within the past year into Malta and some parts of Italy. It feeds on the leaves of the castor oil plant.

During the past year the Earl of Clarendon, Foreign Secretary, has not only introduced into Great Britain numerous living plants of the "Argan" tree of Southern Morocco, (celebrated for yielding fodder for cattle in the husks of the fruit, oil similar to olive-oil in the nuts, and a beautiful wood in its trunk,) but he has also imported, in the finest state for germination, large quantities of seed, which have been freely distributed throughout the country and in the Colonies.

At the last Annual State Fair of New York, three Cashmere goats were exhibited by Dr. Davis, of South Carolina. It is the animal of which the Cashmere shawls are made, the value of which does not depend, as many suppose, upon their rarity, but upon the fact that the material surpasses every other like article in its capacity for wear. The Cashmere goat was introduced into South Carolina several years ago, by Dr. Davis, from the interior of Asia Minor, and the breed has since been carried into the adjoining States of North Carolina, Georgia, Alabama, Tennessee, and Florida, and mixed with the native goat. The hair of the animal, which is pure white, is most beautiful. It somewhat resembles in appearance the finest portion of the fleece of the Chinese sheep, a few of which are on exhibition. It is curly, soft in texture, and brilliant in appearance. The animal is extremely delicate in shape, though hardy. A sock made from the hair was shown with the goats. We learn that the meat is white and delicate, and is preferred in the parts of South Carolina where they are reared to mutton. A herd will protect itself against dogs, which constitutes a great advantage over sheep in localities where dogs are troublesome. Throughout South Carolina the ordinary animal has risen largely in price from the facility with which the breed is improved by this cross.

The Garden of Plants, at Paris, has also recently received for the purpose of acclimation and propagation in France a number of *Yaks* from China—an animal which Buffon says "is more precious than all

the gold of the new world." In Thibet and China this animal serves as a horse, an ass, a cow, and a sheep; it bears heavy burdens, draws large loads, supplies milk, has flesh which is excellent, and hair which can be wrought into warm cloths. To naturalize them, therefore, in Europe would be an immense service to mankind; and as they bear cold bravely, the French naturalists have every hope that they will be able to do so. Some Chinese have been brought over to attend the *Yaks*, and they will teach the French the way of treating them and of curing them in sickness. The *Yaks* are of lowish stature, are singularly shaggy, and have tails more bushy than those of horses.

It is to be hoped that the people of the United States will take their share in endeavoring to accustom Asiatic and African animals to our climates. It is not very creditable to our boasted nineteenth century, that in this respect it is far behind the old Romans. Out of the many thousand species of which the animal creation consists, only between forty and fifty are, in fact, domesticated.

Some attempts to introduce the new system of breeding fish have been successfully made in the United States. Mr. R. L. Pell, of New York, in a recent communication to the Farmers' Club of the American Institute, stated that he had taken the spawn from the female shad and impregnated it with the male shad, and that the eggs produced shad in great numbers. He has numerous fish ponds, in which there are forty-five varieties of foreign and native fish, *thousands of which come at the ringing of a bell to be fed out of his hand.* Sturgeons nine feet long may be seen in his ponds.

Mr. Pell has made arrangements to import the *Ova* of the Tench, Barbel and Carp from Europe, for his ponds, and likewise the spawn of the famous Turbot and Sole.

At the State Agricultural Fair of Ohio, specimens of trout propagated artificially were exhibited.

The electrical loom, invented by Bonneli, as a substitute for the Jacquard, excites much attention in Europe. Some reject it out and out; others consider it as an important invention. An improvement in the Jacquard loom has also been made by a Mr. Acklin. He has succeeded in substituting paper for the pasteboard patterns, which produces an enormous economy in the use of the Jacquard loom.

When the Pilgrims came to New England, they may be said to have brought over with them their Universities, so early did they institute the Universities of Cambridge and New Haven. The same blood warms in the veins of the Oregonians. Their territory is yet but a babe—so small that every additional company's arrival, by sea or over the plains, is chronicled as matter of important bearing on its growth. Still it is old enough to lay the foundations of a school for

instruction in the classical languages, and all the branches that are taught in the highest Eastern institutions. It is organized under the name of the Pacific University, at Tualatin, O. T.

The State of Tennessee has ordered a geological survey of its territory, and appointed to the work Prof. J. M. Safford, of Cumberland University, Tennessee. Prof. S. is well prepared for his duties, and his final reports will beyond doubt prove both valuable and honorable to the State and to Science.

Dr. William Kitchell, of Newark, Secretary of the New Jersey Natural History Society, has received the appointment of Superintendent of the Geological Survey authorized by a recent act of the Legislature of that State. Mr. Henry Wurtz has also received the appointment of chemist and mineralogist to the survey. The work has been entered upon and vigorously prosecuted during the past season.

The geological survey of Illinois, under Dr. Norwood, has revealed numerous localities of marble of great beauty and value. Among these is a variegated variety, suitable for any description of in-door and ornamental work, as mantels, table-tops, &c. It is from Southern Illinois, and will compare favorably with most of the imported marbles used for such purposes. It resembles most nearly some varieties of Egyptian marble. A beautiful Oolitic marble, from Hardin county, receives a fine polish, and appears to be harder and better able to stand the effects of the weather, than a similar rock from St. Genevieve, Missouri, which has been used to some extent in St. Louis. The structure of this rock is as curious as the wrought samples are beautiful. In Pike county a variety of marble conglomerate, resembling the "Potomac" marble of which the pillars in the Capitol at Washington are constructed, also occurs abundantly.

In the United States, great additions to the fossil botany of the carboniferous formation have been made by Dr. Newberry, of Cleveland, Ohio. A severe loss to science in this department was sustained in the death of Mr. Teschmacher, of Boston, who had done much towards elucidating the question as to the character of the plants comprising the mass of the anthracite and bituminous coals.

A new work on American Geology, with full illustrations of the characteristic American fossils, with an atlas and geological map of the United States, has been commenced by that veteran in science, Dr. Ebenezer Emmons, of Albany, N. Y. The first number only has as yet been published. The work is to be exclusively American in all its illustrations and descriptive fossils. This work merits, and from the ability and known attainments of the author will doubtless receive, the attention of all interested in geological progress.

Within the past few years great attention has been bestowed in the United States upon the study of the microscope, and its application to anatomy, physiology and pathology. "Most of the young physicians," says Dr. Holmes, of Boston, in a late communication to the Boston Medical Journal, "who complete their studies in Europe bring home a 'Natchet' or an 'Oberhauser,' and a certain amount of skill in handling it, which they find abundant leisure to improve in the early times of their practice.

"There are now many good instruments among us in the hands of those who know how to use them, and many of the highest excellence. Our microscopists are beginning to be known somewhat beyond their own immediate circle. Dr. Dalton and the late Dr. Burnett have been honored by two of the four prizes conferred by the American Medical Association for essays based in great part wholly on microscopic investigations. Other observers are at work, who will be heard from in due season; and it would not be surprising to find, in ten years from this time, that there were more microscopists in America than in Europe. In the mean time attention has been drawn in this country to the art of making the instruments upon which so many departments of medical science are more or less dependent. Mr. Spencer's labors and triumphs are well known."

Mr. Alvan Clark, of Boston, and Mr. J. B. Allen, of Enfield, have also constructed instruments which compare favorably with the best of imported glasses of similar power. Thus there is growing up amongst us a market for microscopes and all that belongs to the microscopic art, and skill which has never failed to show itself whenever it has been called for will find a new channel in providing for this want.

The art of minute *injection*, and the preparation of objects for microscopical preparations, has been until of late very little practised in this country. Specimens of great beauty have been prepared by Dr. John Neil, of Philadelphia; and Dr. Durkee, of Boston, has also succeeded, after many trials, in acquiring, to a great extent, the skill which is almost confined to a few persons abroad, who make a business of preparing objects for microscopists.

"The microscope," says the author above referred to, "is of all philosophical instruments the most unfailing and untiring companion. The astronomer tells us that hardly more than a dozen nights in a year are adapted to his observations. He must watch all night, exposed to cold and damp, surrounded by costly and cumbrous machinery. The microscopist sits down at his fireside or his window with a little instrument before him, a mere toy to look at—a giant mightier than the slave of the lamp or the ring in its power of trans-

formation. All that he wishes to observe upon Nature is ready to furnish him. Nothing is too precious or rare for him to covet; he wishes but a mere speck, a particle, such as the Koh-i-noor could spare him. Nothing is repulsive, examined in its infinitesimal shape. The disease which infected the wards of a hospital does not betray itself in the narrow apartment where he studies all its intimate details. He may study and work until *practice* comes and takes him off his feet and floats him away into a world of other cares and duties, and, year after year, every day will bring him something new to examine. I will say nothing of the utility, even the necessity, of the microscope to the practical physician and the surgeon. As a mere illustrative companion to scientific study, as a mere intelligent plaything, it is the most precious gift to all who love to look at the universe as its inner life is revealed to the senses."

In a recent sitting of the Natural History Society of Bonn, M. Von Siebold, an eminent naturalist, read an interesting paper "on the State of the Natural Sciences amongst the Japanese." Their knowledge of these sciences is much more extensive and profound than is supposed in Western Europe. They possess a great many learned treatises thereupon, and an admirable geological map of their island by Buntsjo. They are well acquainted with the systems of European naturalists, and have translations of the more important of their works. They have a botanical dictionary, in which an account is given of not fewer than 5,300 objects, and it is embellished with a vast number of well-executed engravings. The flora of their own island is admirably described in a work by the imperial physician, Pasuragawa.

The practicability of inter-oceanic communication by the construction of a ship-canal across the Isthmus of Darien, between Caledonia Bay, on the Caribbean Sea, and the Gulf of San Miguel, on the Pacific, has long been a subject of much speculation and controversy among men of science and learning. The magnitude of the work and wonderful influence which its successful accomplishment might exert upon the commerce of the world, and more especially upon the intercourse between our Atlantic and Pacific possessions, induced the United States government to despatch Lieut. Strain, U. S. N., on a tour of exploration, accompanied by a party of officers, engineers and civilians. The expedition arrived at Port Escocean, Caledonia Bay, in January, 1854, and proceeded at once to the discharge of the duty assigned. The majority of the members of the expedition succeeded in crossing the Isthmus and returning, after enduring great hardships and sufferings. A few of the party, unable to bear up under the fatigue, expired on the way. The opinion arrived at by

Lieut. Strain is, that the work is totally impracticable, and his report is considered as settling the question forever.

The return of Dr. Rae, from an expedition despatched by the Hudson Bay Company in search of Sir John Franklin, has furnished conclusive evidence respecting the fate of the lost navigator and his gallant companions — evidence that leads to the conviction that the end of these hapless adventurers was of the most horrible description. As told by Dr. Rae, it would appear that he fell in with some Esquimaux in Pelly Bay, who possessed many small relics of the exploring party of the Erebus and Terror — watches, silver spoons, telescopes, and other things; and the account they gave of how and where they found these relics was to the following effect: — In the spring of 1850, about forty of the ships' companies were seen by some Esquimaux — not Dr. Rae's informants — on the ice near the north shore of King William's Land. They were going south, and dragging a boat with them over the ice. They looked worn and emaciated; they signed to the natives that their ships had been crushed by the ice, that they were short of food, and were then in search of deer. The natives sold them a small seal, and they went their way — to be seen no more alive. Later on in the year, but before the breaking of the ice, the Esquimaux again came on their encampment, but not a single soul was living. The story was, however, plainly pictured to their eyes. Thirty bodies were found, some partly buried; some in the tents where they had died; some under the boat which they had overturned to form a shelter. They had all perished of starvation, and it was thought that some of the survivors had been driven in the extremity of hunger to the last act of maddened human beings.

Such is the dismal story told to Dr. Rae by the Esquimaux, by way of accounting for their possession of the watches, plate, spoons, and other things.

The Secretary of War, in his recent report to Congress, adverts to, and succinctly describes, the improvements which have been made of late in muskets and rifles. He says, "Though our arms have heretofore been considered the best in use, recent inventions in Europe have produced changes in small arms which are now being used in war, with such important results as have caused them to be noticed among the remarkable incidents of battles, and indicate that material modifications will be made in the future armament of troops. The superiority of the grooved or rifle barrel and elongated ball, in range and accuracy of fire, has long been known; yet the difficulty of loading this weapon has hitherto, for most military purposes, counterbalanced its advantages. To overcome this difficulty, two methods have been proposed. The first, by loading the piece at the breech,

has been for some time in use, but has defects which all the ingenuity expended on it has failed to entirely overcome. The second method, which has produced the important results above indicated, is to use an oblong ball of such diameter as to be readily introduced into the piece, but which afterwards is expanded so as to fill the caliber. This was at first done by providing a rest or support at the junction of the chamber with the bore, as in Capt. Delvigne's method, or by means of a solid pillar in the axis of the barrel, upon which the ball rested and was expanded by blows from a heavy rammer. This was the plan of Col. Thomenin, of the French army, and is known as the system '*à la tige*,' which has been extensively used in their service. The same object was subsequently attained by inserting into the rear part of the ball a conical iron cup, which, being driven into the lead by the explosion of the charge, acted as a wedge to expand the ball. This is the plan known by the name of its inventor, Capt. Minié, of the French army. Still more recently in England the ball has been improved so as to expand by the force of powder alone, without the aid of the cup. This is known as the Pritchell ball, having been brought into use by Mr. Pritchell, a gunmaker of London. This idea also had been suggested by Capt. Delvigne. My attention being drawn to the subject, I directed experiments to be made by the Ordnance Department, both as to the proper shape of the ball, and the best mode of grooving the barrel. In the course of these trials some important conclusions were reached, agreeing, as was afterwards ascertained, with the results of the investigations then making in Europe. Although our experiments have been confined to our service rifle, and are yet incomplete, they confirm the great superiority claimed for this invention abroad. They show that the new weapon, while it can be loaded as readily as the ordinary musket, is at least equally effective at three times the distance; and the foreign experiments indicate a still greater superiority of the new arms. These results render it almost certain that smooth-bored arms will be superseded as a military weapon."

The obituary of 1854 includes the names of many distinguished in science, whose loss will be severely felt — Melloni, Edward Forbes, Prof. Jameson, Prof. Petersen, of Altona, the successor of Schumacher, Dr. Newport, Waldo I. Burnett. The last of the year brings intelligence of the death of that intrepid African traveller, Dr. Barth, who has fallen a victim to the climate near Timbuctoo. Dr. Overwey, his companion, it will be remembered, died in 1853. The scheme of Central African exploration seems likely to terminate as fatally as that of exploration in the polar regions. Man is forbidden to reach that inhospitable limit of the earth's surface.

THE

ANNUAL OF SCIENTIFIC DISCOVERY.

MECHANICS AND USEFUL ARTS.

IMPROVEMENTS IN NAVIGATION.

During the past year, the British Government, acting under the suggestions of the British Association and the Royal Society, have organized a department for the collection of statistics, publication of charts, &c. &c., substantially on the plan originated and carried out by Lieutenant Maury, of the United States National Observatory.

This department has been placed in charge of Captain Fitzroy, who at the last meeting of the British Association, furnished the following communication relative to this subject.

The maritime commerce of nations having spread over the world to an unprecedented extent, and competition having arrived at such a point that the value of cargoes and the profits of enterprise depend more than ever on the length and nature of voyages, it has become a question of the greatest importance to determine the best tracks for ships to follow, in order to make the quickest as well as the safest passages. The employment of steamers in such numbers, the general endeavor to keep as near the direct line between two places (the arc of a great circle) as the intervening land, currents, and winds will allow, and the improvements in navigation, now so prevalent, have caused a demand for more precise and readily available information respecting all frequented parts of the oceans. Not only is greater accuracy of detail required, but much more concentration and arrangement of very valuable, though now scattered, information. Besides which, instrumental errors have vitiated too many results, and have prevented the greater portion of the meteorological observations hitherto made at sea from being considered better than approximations. "It is one of the chief points of a seaman's duty," said the well-known Basil

Hall, "to know where to find a fair wind, and where to fall in with a favorable current;" but with the means at present accessible, the knowledge of such matters can only be acquired by years of toil and actual experience, excepting only in the greater thoroughfares of the oceans, which are well known. Wind and current charts have been published of late years, chiefly based on the great work of the United States Government, at the suggestion of, and superintended by, Lieutenant Maury; and by studying such charts and directions, navigators have been enabled to shorten their passages materially; in many cases as much as one-fourth, in some one-third of the distance or time previously employed. Much had been collected and written about the winds and currents by Rennell, Capper, Reid, Redfield, Thom, Piddington, and others; but general attention was not attracted to the subject, however important to a maritime country, till the publication of Lieutenant Maury's admirable observations. Encouraged by the practical results obtained, and induced by the just arguments of that officer, the principal maritime powers sent duly qualified persons to assist at a conference held at Brussels, last year, on the subject of meteorology at sea. The report of that conference was laid before Parliament, and the first direct result of it was a vote of money for the purchase of instruments and the discussion of observations. All the valuable meteorological data which have been collected at the Admiralty, and all that can be obtained elsewhere, will be tabulated and discussed in this new department of the Board of Trade, in addition to the continually accruing and more exact data to be furnished in future.

A very large number of ships, chiefly American, are now engaged in observations, stimulated by the advice, and aided by the documents so liberally furnished by the United States government, at the instance of Lieutenant Maury, whose labors have been incessant.

Not only does that government offer directions and charts, gratis, to American ships, but also to those of our nation, in accordance with certain easy and just conditions.

In this country, the government, through the Board of Trade, will supply a certain number of ships which are going on distant voyages with "abstract logs," (or meteorological registers) and instruments, gratis, in order to assist effectively in carrying out this important national undertaking.

In the preface to a late edition of Johnston's Wind and Current Charts, published last June, at Edinburgh, Dr. Buist says: "It has been shown that Lieutenant Maury's charts and sailing directions have shortened the voyages of American ships by about a third. If the voyages of those to and from India were shortened by no more than a tenth, it would secure a saving, in freightage alone, of 250,000*l* annually. Estimating the freights of vessels trading from Europe with distant ports at 20,000,000*l* a year, a saving of a tenth would be about 2,000,000*l*; and every day that is lost in bringing the arrangements for the accomplishment of this into operation occasions a sacrifice to the shipping interest of about 6,000*l*,

without taking any account of the war navies of the world. It is obvious that, by making a passage in less time, there is not only a saving of expense to the merchant, the shipowner, and the insurer, but a great diminution of the risk from fatal maladies, as, instead of losing time, if not lives, in unhealthy localities, heavy rains, or calms with oppressive heat, a ship properly navigated may be speeding on her way under favorable circumstances. There is no reason of any insuperable nature why every part of the sea should not be known as well as the land, if not indeed better than the land, generally speaking, because more accessible and less varied in character. Changes in the atmosphere, over the ocean as well as on the land, are so intimately connected with electrical agency,) of course including magnetism,) that all seamen are interested by such matters, and the facts which they register become valuable to philosophers. Meteorological information collected at the Board of Trade will be discussed with the twofold object in view—of aiding navigators, or making navigation easier, as well as more certain, and amassing a collection of accurate and well-digested observations for the future use of men of science. As soon as the estimate for meteorological expenses had passed, steps were taken to organize a new branch department at the Board of Trade. On the first of August, Captain Fitzroy was appointed to execute the duties of this new office, referring to Dr. Lyon Playfair, of the Department of Science and Art, and to Admiral Beechey, of the Marine Department, for such assistance as they could render. As soon as registers and instruments are ready, and an office prepared, Captain Fitzroy will be assisted by four or five persons, whose duties he will superintend. It is expected that several ships will be supplied with 'abstract logs' (meteorological registers) and instruments in October, and that the office will be in full work next November. The admiralty have ordered all the records in the Hydrographical Office to be placed at the disposal of the Board of Trade for a sufficient time. All other documents to which government has access will be similarly available; and the archives of the India House may likewise be searched. There will be no want of materials, though not such as would have been obtained by using better instruments on a systematic plan. Captain Fitzroy ventures to think that the documents hitherto published by Lieutenant Maury present too much detail to the seaman's eye; that they have not been adequately condensed; and therefore are not, practically, so useful as is generally supposed. His Instructions, or Sailing Directions, (the real condensed results of his elaborate and indefatigable researches,) have effected the actual benefits obtained by mariners. Reflecting on this evil, which increasing information would not tend to diminish, Captain Fitzroy proposes to collect all data, reduced and meaned, (or averaged,) in a number of conveniently arranged tabular books, from which, at a subsequent period, diagrams, charts, and 'meteorological dictionaries,' or records, will be compiled, so that by turning to the latitude and longitude, all information about that locality may be obtained at once, and distinctly."

IMPROVEMENTS IN SHIPS AND STEAMERS.

During the past year a steam-vessel, involving some new principles of construction, has been built in Scotland, to be used in deep-sea fishing. The vessel is 100 feet long, with engines of thirty-horse power. Externally there is nothing to distinguish it from a sailing vessel, except the presence, on each side of the hull, of a curved pipe 10 inches in diameter, termed a "nozzle," communicating with a water-tight iron case inside. In the bottom of the vessel are apertures admitting the water into the water-tight case with a horizontal wheel fixed on a crank-shaft attached by piston-rods to the engine, and on the steam being applied, the water-wheel revolves with velocity, and the water is discharged by the nozzles on each side of the vessel. These form the only propelling power, and the invention is remarkable for its simplicity and effect. These nozzles also are of service in navigating the vessel, which, according to the angle of depression or elevation, turns in any direction, or stops altogether, even with the engines working at full power. Although capacity rather than speed was studied in the construction of the vessel, it easily attained 11 knots an hour. Economy of fuel, freedom from vibration, light draught, and a high rate of speed, are among the advantages of the invention. The vessel is being schooner-rigged, and when fitted with boats and fishing gear, it will proceed to the fishing-ground in the Firth of Forth, and by lowering the boats and crews, will be able to conduct the fishing operations with safety and celerity.

A new propeller, called the "Brandon," has recently been built at Glasgow, Scotland, which is fitted with engines of a somewhat novel and peculiar construction. The Brandon has four engines, all double-acting, and standing in a vertical position at considerable distances apart in a massive framing of cast-iron. In the forward pair the port engine receives the fresh steam from the boiler and discharges it into the starboard and larger one, while in the after pair this arrangement is reversed, and the starboard is the smaller or high-pressure cylinder. The two starboard engines are connected to cranks keyed at right angles on the ends of a stout shaft lying horizontally fore and aft overhead. The port engines are connected to a similar shaft, and each of these shafts carry large wheels nearly opposite each other with wooden cogs, which mesh into a smaller pinion on the propeller shaft below. The steam is admitted into the smaller cylinders at a pressure of about 20 pounds above that of the atmosphere, and expanding by the lap of the valve merely diminishes its pressure to about 15 when the stroke is completed, at which time the valve opens, admitting the steam to the same end of the corresponding low-pressure engine, then on the opposite centre. This second engine is designed to expand the steam to as low a pressure as is economically practicable, the stroke of piston in all the engines being three feet and the diameter of the high-pressure 41, while that of the low-pressure is 64 inches. The ratio

of the capacities of the high and low-pressure cylinders being about as one to two and a half, the steam may be supposed to be finally expanded in about that ratio, and the effect of each pair is theoretically equal to that of a single cylinder of 76 inches diameter, in which the steam is cut off at two-fifths of the stroke and expanded through the remainder. There are two vertical air-pumps, one on each side, worked by eccentrics on the upper shafts. There are many details of considerable novelty, among which may be mentioned a set of small valves or cocks suitably connected for working, or rather for "warming" the engines by hand.

The immense steamship contracted for by the Eastern Steam Navigation Company (England) is in the course of completion, by Mr. Scott Russell. The extreme length on main deck will be 700 feet, being 430 feet longer than the Himalaya steamer; extreme length of keel, 680 feet; extreme breadth of beam, 83 feet; depth of hold, (forming four decks,) 58 feet; length of principal saloon, 80 feet; height of ditto, 15 feet; tonnage, 10,000, or builders' measurement, 22,000 tons; stowage for coals, 10,000 tons; stowage for cargo, 5,000 tons; 500 first-class cabins, with ample space for second and third-class passengers, besides troops, etc., while her screw and paddle engines will be of the aggregate nominal power of 2,800 horse. She will also carry an immense quantity of sail. The principle of construction, as designed by Mr. Brunel, will be similar to that of the tube of the Britannia Bridge. Her bottom, decks, and sides are to be double, and of a cellular form, with two feet six inches between. She will have fourteen water-tight compartments, also two divisional bulk-heads running her whole length. The great length of the ship, it is contended, according to all present experience, will enable her to pass through the water at a greater velocity, with a similar power in proportion to her tonnage, than ordinary vessels now require to make ten knots an hour, and that speed is, in fact, another result of great size. The immense proportions will admit of carrying sufficient fuel to accomplish a voyage round the world.

The largest ocean steamships (says the *Sailors' Magazine*) now plying on the Atlantic, bear precisely the proportions in length, breadth, and depth, that are recorded concerning Noah's Ark. The dimensions of the Atlantic steamers are: length, 322 feet; breadth of beam, 50 feet; depth, 28½ feet. The dimensions of the Ark were: length, 300 cubits; breadth, 50 cubits; depth, 30 cubits. The Ark, therefore, was nearly twice the size, in length and breadth, of these vessels, the cubit being twenty-two inches; both had upper, lower, and middle stories. After all the equipments of forty-two centuries, which have elapsed since the Deluge, the ship-builders have to return to the model afforded by Noah's Ark.

At the last meeting of the British Association, Mr. Scott Russell gave a lecture upon the progress of naval architecture and steam navigation, including a notice of the large ship of the Eastern Steam Navigation Company. It was mainly in respect to speed that the great improvements in the last twenty years had been made. Within that time the principle and the means of gaining speed had become definitely known, and this

Association had had a great deal to do with the establishment of that principle, which consisted mainly in the particular formation of the water lines of the vessel. The old ships had a round, bluff, duck's-breast bow, with a sloping narrow stern. At length the idea was arrived at of making a boat with a bow, the water lines of which should correspond with the wave of the sea itself, which should gently and gradually divide the particles of water, which would then give a quiet and easy passage to the vessel entering, whether propelled by steam or by sails, without resisting their progress, and heaping a mound of water before the bows, as in the case of the old bluff, round-built vessels. It seemed now to be universally admitted, in Europe and in America, that if a ship-builder wanted to have a very easy and fast-going ship, he must give her bow, not the round convex line formerly adopted, but a fine, long, hollow line, such as the meeting might observe for themselves in all the recently-built vessels. Practical men, when they desired to build a fast ship, saw that they must now no longer use the convex water line, but they must build with a hollow water line at the bow, and in this consisted the great revolution which had taken place during the last twenty years. Whereas formerly the broadest part of the vessel was only a third part from the bow, the broadest part was now nearer to the stern than to the bow in the proportion of two to three, so that the shape of the ship under the water was very nearly reversed. The ship out of the water might remain very nearly the same, but where she cut the water, the lines were as he had described. It was on this principle that American clipper ships and English ships which happened to be very fast were built, and upon which he would say, without fear of contradiction, every vessel, to gain any thing like sixteen miles an hour, must be built. Now, there was, in addition to this, another very important principle which had been discovered. That was the virtue of the length. It used to be a dogma in the time of his pupilage, that no steamboat could ever, by any possibility, go faster than nine statute miles an hour. He was born and bred in that belief. Nine statute miles an hour was the creed of his instructor in ship-building. At that time they had very short vessels, and they endeavored, by putting enormous power in them, to compel them to go through the water, whether they would or not. He remembered being present at the trial trip of a vessel out of which had been taken fifty-horse power engines, and engines of seventy-horse power substituted. It was a most extraordinary fact, that she only gained something like a quarter of a knot an hour by that enormous addition to her power and fuel, because she had not sufficient length to go by any force at a high speed; and the more she was driven through the water, the greater was the resistance made by the water which she raised before her. The principle was ascertained, that if you wanted the particles of water to go out of the way of the vessel when going very fast, you must give the particles more time to do so. Now, this might appear a contradiction in terms, but the faster the vessel was to go through the water, the more time must be allowed to the particles of water to give way. It was found that

it was more easy to push a vessel with an elongated body through the water, at great speed, than the short vessels which had been in use. This was reduced to a regular principle, the result of which was, that it was now certain that 24 feet of length in the entrance lines of a vessel would give eight miles an hour easily; to go at sixteen miles an hour, the entrance lines should be nearly 96 feet long. To give twenty-four miles an hour, the entrance should be 216 feet long; so that they could not expect to get twenty-four miles an hour until they had made up their minds to build ships something like 400 feet long. From all the experiments he had made, and had seen made, these facts were undoubted. The clipper ships and fast steamers had lengthened their bow-lines until they had got the necessary length for speed; and if those present looked at any vessel which had got the reputation of going sixteen miles an hour, he believed they would find that to be the fact. Indeed, he did not believe there was in existence a vessel shorter than one hundred and eighty feet which could go sixteen miles an hour; and if there were any such vessel forced to go more than sixteen miles, it was an expenditure of power which was perfectly preposterous. They would therefore perceive why such a large vessel as the Himalaya had such great speed. The Himalaya had a length of three hundred and fifty feet, and should have the greatest speed for the smallest power of any merchant vessel hitherto. If, in like manner, they looked at the large clipper ships of two thousand and three thousand tons burden now built, they would find that the principle was taken advantage of, and that their bows were elongated to a great length. But what else was being done? The owners of the clipper ships were finding out that, by the lengthening of the bow and making the lines more hollow, they could reduce the sails and spars, and yet preserve their speed, finding that the ships could now do in the water what force of canvas could never alone accomplish. Like every truth, the shape of a vessel had been long since found out and lost again. The old London wherry was built as perfectly upon the lines he had described as if it had been mathematically constructed upon them. In India the boats were made precisely upon that form, and they were the fastest boats in the world, as a class. The Turkish caiques had the same shape, and they were very fine vessels. In Spain they had arrived by some means at a form not very different, and throughout the whole of the last war the Spanish vessels were the best vessels, and the best England took. The smugglers, because they risked their necks upon the speed of their ships, quickly found out what shape was best, and some of the most beautiful ships that ever came into our possession in that way were built in that form. The Americans had made very early an experiment of the kind in steamboats. They lengthened their steamers at a very early period, and they now generally built upon this plan and with the hollow lines. They had done wonders in this way, and he believed in England wonders were also being done. It was not easy to carry the elongating of the vessels much further in wooden ships, because they could not get timber

large enough, and it was impossible to make it strong enough by joining; but he believed Professor Fairbairn had discovered the means of joining iron so as to make it equal in strength to solid metal. Having alluded to the building of the Great Western, and subsequently of the Great Britain, and the prophetic doubts expressed at first regarding the fate of each, the speaker proceeded to describe the great vessel now being built by him upon the Thames, for the Eastern Steam Navigation Company, to trade with India and Australia. He showed how the difficulty of carrying coals, and having to stop for them and buy them at high rates at St. Vincent and the Cape of Good Hope, and sometimes the Mauritius, created such an expense that no freights could cover; he showed how it became necessary to construct a vessel large enough to carry her own coals all the way. When, therefore, he told them that the vessel being constructed was expected to make the voyage to Australia in 30 days, carrying a sufficient freight, with 600 first-class and 1,000 second-class passengers, having three large tiers of decks, eight feet each in height,—that she was 675 feet long, 83 feet beam, 60 feet deep,—when he told them that he had just measured St. George's Hall, and found that it would not fairly represent this ship, being only 169 feet instead of 675 feet long,—that up to the top of the hall it was only 82 feet high, and up to the spring of the arch about the height of the ship,—that the breadth of St. George's Hall was only 77 feet, being six feet narrower than the hold of the ship,—it would give them the nearest approximation he could convey to the size of the vessel. Mr. Russell concluded by a prediction, in eloquent terms, of the glorious effects to civilization which would ensue from the noble rivalry existing at present among individuals and nations in the advancement of science. In reply to a question afterwards put to him, he stated that the huge vessel which he had described would draw twenty feet when light, and thirty feet loaded.

Mr. Fairbairn had no hesitation, judging from the drawings he had seen, and from the principle of the vessel, in saying, that she would be perfectly suitable, strong, and calculated to carry out the object for which she was designed. When they were able to construct the Britannia Bridge, 460 feet long, without any support in the middle, and could run a train through it, there could be no doubt that such a vessel as had been described could carry the weight and resist the opposition necessary.

FISHER'S VENETIAN SCREW-PROPELLER.

The object of this propeller is to prevent the retardation which occurs in an ordinary screw-propeller, by the tendency to produce a vacuum at the back of the blades of the propeller. To effect this, Mr. Fisher makes slits in the blades to allow the water to pass through, and thus to supply the place of the fluid which is drawn backward as the screw turns round. These slits give the propeller somewhat the appearance of a Venetian blind,

and hence its name. Mr. Grantham said the propeller had been tried in the Birkenhead Docks with good effect.—*Proc. British Association.*

CUNNINGHAM'S PLAN FOR REEFING TOPSAILS.

This plan consists of an arrangement by which the yard-arm is made to turn round as it is lowered by a pulley fixed to the mast, and the slit in the centre of the sail through which the rope passes, to effect that movement of the yard-arm, is closed by a sail-cloth valve that preserves the action of the sail intact.

APPLICATION OF THE SCREW-PROPELLER TO SHIPS OF WAR.

The following extract from a report to the Secretary of the Navy, by Lieutenant Walker, on the applicability of the screw-propeller to existing ships, will be found interesting :—

One of the most interesting and important subjects to which I directed my attention while abroad, was the results of the trials that have been made in France to test the applicablity of the screw-propeller to ships of war of the largest class. Many of these results have not yet been publicly made known, and I found many obstacles in the way of a thorough investigation of the subject. The officials to whom I applied for information, with a great deal of outward politeness and apparent readiness to oblige, were evidently indisposed to afford an officer of a foreign service all the desirable means of becoming acquainted with improvements from which they hoped to reap advantages. I succeeded, however, in obtaining some reliable information upon this important subject, and now subjoin the results of my investigations ; but I think it necessary to remark that more extensive personal examination and observation, both in France and England, than I was permitted to make, is necessary, in order to enable the department to judge of the eventual success of the experiments in both countries.

The French have afloat eight ships-of-the-line, five of which have already been fitted with propellers, and the remaining three are now receiving their machinery. Of these, the Charlemagne, the Napoleon, and the Montebello have been at sea, and have performed so well that the most sanguine hopes are entertained that the adaptation of the screw to ships-of-the-line will vastly increase the effective force of their navy.

The Napoleon is the only one of these ships constructed especially for a propeller. Her dimensions are as follows :—

	Feet.	*Inches.*
Length, extreme,	262	6
At load line,	234	
Beam,	53	
Height between decks,	6	8
Height of lower port still above water line,	7	2
Depth of hold,	26	9
Diameter of cylinder,	8	2
Length of stroke,	5	3
Diameter of propeller,	19	

She is supplied with eight boilers, each having five furnaces; and at full speed, which is about twelve knots, consumes one hundred and two tons of coal per diem.

The boilers and machinery take in the length of the hold, 82 feet, which, for a nominal power of one thousand horse, is considered excessive.

The results of the trial of the Napoleon have sufficiently established the fact of the practicability of so adapting a propeller to a ship of the largest class as to insure great speed, and form a most effective man-of-war, for certain purposes and in certain situations; but when the great weight of the engines and coal is considered, and the great space they necessarily occupy in the vessel, (thereby diminishing the stowage of provisions and water,) and when we further reflect that after the coal is expended the ninety-gun ship has only the spars and sails of a sixty-gun ship to rely upon, we are forced to the conclusion that, however useful such a vessel may be for short passages, and in those seas where her supply of coal and provisions may be constantly replenished, yet that her sphere of action must be very limited, and that she could not be relied upon for the long cruises and various service on which an ordinary line-of-battle-ship is employed.

A ship constructed on the model of the Napoleon, for the sake of gaining a speed of ten or twelve knots per hour for the distance of about 2,400 miles, is compelled to sacrifice a great part of her efficiency in several other most important particulars.

In time of war, at short distances from port, for the defence of harbors and bays or the Florida Channel, and for the general purpose of defending a coast, to force a blockade, or for the speedy transport of troops to an adjacent territory, such a vessel would undoubtedly be a most valuable acquisition to our navy; but her employment must necessarily be confined to such situations and circumstances, for should she be unlucky enough to fall in with a hostile squadron with her coal expended, or with her machinery rendered useless by any of the numerous accidents to which steam machinery is constantly exposed, with her comparatively light rig and her want of stability, the consequence of losing so great a weight of coal, she would prove any thing but a formidable antagonist; and it is much to be feared that she would be compelled to strike to any vessel of her class that should attack her.

In France and England the question of adapting propellers to their men-of-war already existing, particularly to line-of-battle-ships, has excited the deepest interest, and has been discussed in all its bearings. In both countries great efforts have been made to ascertain how this adaptation could be effected at the least expense, without injury to the sailing qualities and capacities of the ships, and to discover the best general plan for the necessary alterations.

After a series of the most careful trials, made at the naval station of Rochefort, it was found that there were insurmountable objections to placing an engine of six hundred and fifty-horse power on board a hundred gun-ship. It was then determined to try the experiment with the

Austerlitz, a ship-of-the-line of the same class, then on the stocks at Cherbourg; but after the maturest consideration, the constructors and engineers were compelled to decide that this could not be done under any reasonable conditions; that it would be necessary to cut her in two and lengthen her floor; that her stern must be taken down and rebuilt; and that, after all, these great and expensive alterations promised no satisfactory result.

In consequence of the unfavorable report of the officers upon this subject, the minister of marine directed that an engine of five hundred-horse power should be substituted for that of six hundred and fifty-horse power, which it had been intended to place on board the Austerlitz, in order to ascertain if, with this less powerful engine, and without any reduction in her battery, spars, or other equipment, it was possible to attain a speed of not less than four and a half knots under steam.

The attempt has been made to execute the order of the minister; the stern of the ship has been entirely rebuilt, (with the addition of a "trunk" or "well,") at the cost of 400,000 francs, and on the 14th of September, 1842, she was launched; but it was found quite impossible to comply with all his requirements in relation to the armament and equipment of the ship.

I cannot, of course, give any very minute detail of those particulars in which it was found necessary to deviate from the plan of the government, but I have ascertained that her battery has been reduced to eighty-eight guns; that her munitions of war have been diminished one-fourth part; that her spars and sails have been cut down to those of a sixty-gun ship; that she cannot now stow more than one month's water and two months' provisions; and that she has been so lightened by the removal of one hundred tons of ballast and eighteen tons of cables and anchors, as to render her stability under sail, after the consumption of her coal, highly problematical.

ON AN INSTRUMENT FOR TAKING SOUNDINGS.

The following communication from the *Philosophical Magazine*, (vi. 344,) is by F. Maxwell Lyte, Esq.

I see, from what Dr. Scoresby has brought before the Association at Hull, that there seems to be some difficulty about obtaining correct soundings in places where the currents are strong and flow in different directions at the different points of depth, causing the line to assume different curves in its descent; and when it comes to be measured over, after the weight has reached the bottom and been hauled up again, the measurement gives no approximate idea of the real depth. Now it is plain that this mensuration of the depth of water might be as well made by estimating its vertical pressure, as, in measuring the height of mountains, we measure the barometical pressure of the air; and so I would propose to do it by an instrument constructed as follows:—

An accurately constructed tube of gun-metal or brass, or some metal not very easily corrodible by salt water, has a glass tube fitted on to it on

the top, by a screw joint, and again on the top of the glass tube is fitted a strong hollow copper ball by a similar screw joint. The lower tube, which we will call *a*, has a well-turned piston fitted to it, from which runs a rod which is only a trifle longer than the tube, *a*, and just enters the tube, *b*, when the piston is at its lowest point. A well-made spring is placed in the tube, *a*, above the piston, and the tube, *a*, being narrowed at the top so as just to admit the free passage of the rod, and the rod having a little button at its top the piston is kept at its lowest point by the spring, except when sufficient pressure is applied from below to compress the spring. The glass tube has a small ring fixed in it, just so as to stick at any point to which it is pushed, and the button at the top of the rod serves to push the ring straight, and the ring thus forms an index of the degree to which the spring has been compressed. The ball on the top serves as a mere reservoir of air to equalize the action of the apparatus as much as possible. The whole of this apparatus is enclosed in a wire cage, for the sake of protection from blows. To graduate this apparatus, I let it down in a known depth of water, say ten fathoms, and having observed the point to which the ring in the glass tube is pushed, and having marked this point off, the ball is to be unscrewed, and with a small ramrod the ring is to be pushed down till it rests on the top of the piston rod. The ball being replaced, the apparatus is sunk in twenty fathoms; after a similar manner it is sunk in thirty, and next in forty fathoms. This will test the accuracy of the apparatus; and the marks made on the glass tube, *b*, after each trial, will give a scale from which the whole tube may be graduated, even to thousands of fathoms, if the tube be long enough or the spring strong enough. I have been induced to make this communication on account of the great use which may be made of such an apparatus.

SHOAL WATER INDICATOR.

Mr. Edwards, of her Majesty's dock-yard, Pembroke, has recently patented an invention which is to indicate when a vessel, under steam or canvas, comes into water at any given depth. The apparatus is to be employed chiefly in fogs and at night time, and is intended to afford a more certain means of ascertaining when the vessel employing it is nearing a coast or shoal, than is provided by the ordinary soundings. This invention consists of a copper or iron rod, about three-fourths of an inch in diameter, and of any desirable length—say three fathoms. This rod is attached by an eye or other contrivance to the under side of the keel, and is kept in a vertical position by the stays, to which a grapnel and weight are attached, by a line, and which is secured on board the vessel to a lever that has connected to it a weight sufficiently large to counteract the tension produced upon the line by the resistance of the water against it. By means of this, line soundings may, if deemed necessary, be taken, the ordinary lead line being dispensed with.. When the rod or grapnel takes the ground, the line slipping from the lever will cause the reel to revolve,

when a hammer strikes a bell, indicating thereby that the vessel is in shoal water ; the grapnel and weights can be lowered to any depth that may be necessary, or according to the circumstances of the vessel. The whole apparatus is very simple, and can be readily unshipped when not in use.

MACHINE FOR SAWING SHIP-TIMBER.

Sometime in the last century a reward of something like £60,000 was offered by the government of Great Britain for the successful introduction of machinery for shaping ship-timber, and under this liberal inducement Gen. Samuel Bentham—so much noted for his improvements in general wood-working machinery—and the elder Brunel, designed machines which, at one time, promised a tolerable degree of success. These were succeeded by a very massive cast-iron apparatus constructed under the direction of Prof. Farey. The difficulties to be overcome in a machine of this character, are certainly many and serious. We are not aware of the work having been attempted in any other manner than by sawing. The ordinary saw-mill must be modified in two important particulars. The cut must be capable of adapting itself to any required curve, and also to any required degree of "bevel." The timbers near the centre of a ship are simply crooked, but from this point forward and aft, every "futtock" is beveled in a greater or less degree, and this continually varying, even at different points in the same frame. Some pieces near the stern are beveled in various degrees and even in opposite directions, within the length of a single stick.

Bentham's and Brunel's machines were in some degree analogous to that now employed in light "scroll" sawing. The machine of Prof. Farey was so constructed that the movement of the saw-frame, or gate, could be inclined in any required degree, but both devices were abundantly cumbrous and impracticable. The only full-size machine ever constructed on either principle is now standing idle at the Chatham dock-yard—a useless mass of heavy castings. A machine has however been lately introduced by Mr. James Hamilton, of New York, which appears to combine nearly or quite all the elements of success.

In this machine the curves are described by a lateral movement of the saws, while the bevels are produced by a partial rotation of the timber. The stick to be sawn is suspended between centres, and controlled in its position by suitable machinery on the "tail-block." The sawgate is a compound affair, and consists, first, of one principal gate, moving vertically between slides in the usual manner. The crossbars forming the top and bottom are polished bars of round iron, between which are stretched, with liberty to move laterally, two inner frames, each carrying a saw. The saws are so connected to the inner frames, by vertical pintals, that they may be freely turned so as to present their teeth or cutting edges in any direction. This apparatus, with various admirable arrangements of detail,

constitutes the invention which promises completely to supersede the broad-axe and bevel-rule.

Both sides of the timber are cut at the same moment. The rough timber, properly marked with the required curves upon its upper surface, is fed up to the saws in the usual manner. The saws once fairly entered in the wood, and controlled in their position by the hands of the attendant, readily follow (by the free lateral movement of the inner within the main gate) the most difficult curves ever required in practice. Even a transverse cut may be readily made by a proper manipulation of the saws. The devices for controlling the amount of bevel are capable of effecting the most delicate gradation from one end of the stick to the other; and in this respect, as indeed in every other, the work of the machine exceeds in accuracy that of the ordinary tools.

BENDING SHIP-TIMBER.

Machinery for giving different curves and increased strength to heavy timbers used in ship-building and for other purposes, has recently been constructed by the well-known inventor, Thomas Blanchard, of New York. The principle upon which the force is exerted is very simple. An iron model, with a large groove corresponding to the shape of the knee, passes in its whole length under a cogged wheel, whose cogs fit into corresponding grooves in the surface of the model, and performs a semi-circular revolution. It receives into its anterior extremity, which starts under the wheel, the stick of timber to be bent, and fits over it as it lies upon the horizontal frame which supports the machinery, receiving the stick into its groove up to the spot where the curve begins, where the model rises from the frame as the knee of the ship rises from the water. The horizontal framework has also a groove into which the stick is received, and at its further end an iron plate is forced against it steadily by a screw, giving a strong and uniform "end pressure" in the direction of its length. It lies upon a flexible iron band, which is attached to the end of the model, where the stick rests. As the anterior end of the model passes under the cogged wheel and rises to a right angle with the frame, carrying with it the stick of timber bound in its groove by the flexible iron band, its posterior extremity descends fitting over the timber until it is level with the frame. The stick of timber has now taken the shape of the mould, and when cold, retains its shape with as much tenacity as if it had grown into it. It is very evident that when a straight stick of timber is bent into a semi-lunar shape, the fibres of the wood upon the inner side must be packed more densely. The wood is steamed for from half to one hour for each inch of thickness, and put into the machine warm and moist, and as it takes its bent position the inner fibres are impacted without destroying the tissues of the wood, but only increasing slightly its density on the inside of the curve.

It is stated by the inventor that timber thus bent is much stronger and will bear greater pressure than that which has a natural curve. By a slight modification of the moulds or models, which are intended to be made in sections, great diversity of shape, even to a double curve, can be given; and the immense variety of purposes to which this invention can be applied will at once suggest themselves to the mind. It will give increased strength and lightness to furniture requiring curves of wooden material. The principle of making timber flexible by the aid of heat and moisture has been long known and practised upon; and when we see the wonderfully perfect results of such simple but effective machinery, it appears strange that its application should never have been made before the present time. It is supposed that this invention will effect a very great reduction in the cost of ship-timber, and increase the buoyancy of vessels by giving equal strength with a lesser weight of timber. The largest sticks that have yet been bent are but ten inches in diameter; but there appears no reason why sticks of much larger size should not be handled with almost equal facility. The only difficulty to meet would be the increased strength and size of machinery.

IMPROVEMENTS IN RAILROADS AND RAILROAD LOCOMOTION.

Rice's Improved Break.—This break is in the form of a shoe, is located between the wheels, and is intended to act upon the rail, instead of upon the wheel. It is worked by levers, in precisely the same manner as the present wheel breaks. It is composed of a substance softer than the rail, so that there can be very little expense on account of "wear and tear." When the train is in motion, the "shoe," which turns up at each end, so as to avoid hitting bluntly, any slight unevenness, is about a quarter of an inch from the rail, and when the lever is applied, the "shoe" is pressed down in such a manner as to lift the wheels from the track. The contrivance is simple, but effective. The cost of the shoe break is small, and can be easily repaired or replaced. In case a wheel gives, it would not only stay the motion of the train, but would tend to support the car.

Improved Method of Fastening Rails to Cross-Ties.—A method of securing rails to cross-ties without the use of metal fixtures, has been introduced on the Strasbourg Railroad, France. The inventor places the rails directly upon the cross-ties, and secures them by means of two short wooden braces, each bearing with one end against the rail, and with the other against a shoulder cut into the cross-ties; the braces are fastened with wooden pins or iron spikes. It is exceedingly cheap; it secures the rail in the most perfect manner; it is easily kept in repair; the rails are much easier laid down and adjusted; the whole fastening being of wood, it affords, consequently, more elasticity, produces no jarring, and the deafening rattling noise, caused by the friction of the rails upon the iron chairs, is entirely avoided.

Improved Railroad Track.—The improvement of Mr. D. C. Grinell, of New York, consists in making the track of four rails instead of two, or one gauge within another. Each car has trucks of two widths, and there is a double safety against running off. The weight of the locomotive being borne on the double track, may also be greatly augmented, and a much higher rate of speed attained than is now possible. It is estimated, that a road built in this manner, might be traversed with security, at from 100 to 150 miles per hour. The expense would not be double that of an ordinary track, as lighter rails may be used.

An invention of M. Gluckmann, to establish a communication between the breakmen of trains by means of electricity, has lately been tried with success, on the Birmingham and London Railroad. The apparatus consists of two batteries, each one secured within a box, and placed at the opposite ends of the train, connected by a wire, which passes under the cars, and is joined to bells which can be set ringing whenever the attention of the brakemen or conductors is required. The great merit of this invention lies in its simplicity and rapidity of action.

G. K. Douglas, of Chester, England, has patented some improvements in the permanent way of railways. In this invention, the chair is made with two pair of jaws, which are cast together in the usual manner, and are sufficiently wide apart at the top, to admit the rail. Between the jaws and the body of the rail is a plate, enlarged between the jaws, in order to strengthen it, and another plate is held in contact with the other side of the rails, by vertical wedges. These plates and wedges the inventor prefers to make of cast-iron, but they may be made of wood. When the wedge is of wood, it is requisite to have a hole in the chair, through which the wedge can be forced when the rail has to be removed.—*Scientific American.*

At the late fair of the Maryland Institute, a gold medal was awarded to a locomotive engine exhibited by Mr. John Cochrane, the constructing engineer of the Union Iron Works, of Baltimore. The chief peculiarities of this engine consist in the use of a double set of cylinders and driving apparatus, together with an arrangement of the axles, whereby the motion over curves is greatly facilitated. The inventor thus describes it:—

"The wheels of the Binary engine may be considered as divided into two sets, viz: Front and back drivers, each set being operated by a separate pair of cylinders, making four cylinders in all. The pair of cylinders beneath the smoke-box, operate the truck drivers by means of cranked axles, and the outside pair the back drivers by means of crank pins in the wheels. Each pair of cylinders, with their connections and wheels, form a complete system, but are not capable of independent movement, for both systems are so combined together, as to secure a simultaneous action in starting, working, and stopping, and in all the various manipulations necessary to the management of the engine. This is accomplished by combining the outer and inner cylinder of each side respectively, by means of

one steam-chest and valve, which produce a perfect unity of action in both systems."—*Scientific American.*

Oblique Railroad Wheels.—One of the most interesting sights in Paris, is the railroad from the Barrier d'Enfer to Sceaux. It is but seven miles long, and was built as an experiment upon a new system of wheels. The engine, tender, and hindermost car of the train are furnished with oblique wheels, under the ordinary upright ones. Where the track is straight, these do not touch the rails; but at the curves they come into play, rattling along the inner edge of the rails, and preventing the train from running off the track. The road was, therefore, made purposely tortuous, and the most sudden and seemingly dangerous bends were introduced at frequent intervals. The two stations are circular, and the train, as it receives its passengers, is doubled up into a ring of 50 feet radius. The smallest curve upon the road is 68 feet radius, and over this the train goes at full speed. The corners of the cars are cut off, so that the vehicles, in following the curves, do not infringe upon each other. Sceaux is upon an eminence, which the road ascends spirally, with something like a mile of track—it only going, in advance, a hundred feet. The invention—which, by the way, is ten years old—has proved, practically, very successful; but it has never been applied to any extent.

Ruttan's Car Ventilator.—In this invention, which is highly commended, the fresh, pure air is caught, by a projecting box or cap on the centre of the roof, and conveyed down a passage on the inside of the car, through the floor, to a shallow tank beneath. Spreading out here, it deposits its cinders, and, to a considerable degree, its smoke and dust, after which it rises through the stove—which is of peculiar construction, on the principle of a hot-air furnace—and is projected, in every direction, from the top of the stove into the car. The opening for its escape again, from the interior to the open air, is near the floor, and the current of warm, foul air, is conveyed under the entire length of the car, completely protecting the feet of the passengers from the influence of the external cold. Having completed this circuit, it is carried up through suitable passages, and allowed to escape from a cap on the top. These ejecting caps are at each end of the car, to allow of running in each direction, and are closed by light, self-acting valves, opening outward. The current induced by the rapid motion through the air, closes the valve on the forward, and opens that on the hinder one, and each valve is so balanced, by a short loaded lever or tumbling-bob, that the weight tends equally to hold either open or closed. It results from this contrivance, (which may appear paradoxical to some, but is easily constructed by any mechanic,) that whichever position the valves may assume in the most rapid motion, will be maintained until the motion is reversed. The openings from these ejectors or exhausting boxes, into the cars, are controlled by hand, but the only effect of exhausting direct from either end, may be an unpleasant cooling of the floor.

ANTHRACITE COAL FOR LOCOMOTIVES.

The following article is from the *Journal of the Franklin Institute.* Its author is A. Pardee, Chief Engineer of the North Pennsylvania Railroad. The subject is one of increasing importance to our railroad companies, and we wish to give it that extent of circulation which it deserves.

"The use of anthracite coal as fuel, was commenced on the Beaver Meadow Railroad, in 1836, in engines built by Eastwick & Harrison, and has been continued, to the present time, in a portion of their engines.

"On the Hazleton road, we commenced its use in 1838, in the 'Lehigh' engine, built by Eastwick & Harrison, and in 1839, in the 'Hercules,' by same makers. Both engines have been in constant use during the season of navigation, say eight months per year, up to and including 1852, when the 'Lehigh' was taken into the shop to be rebuilt. The 'Hercules' is still in use.

"Both engines had, originally, copper flues, which were replaced by iron ones after about two years' use, the copper having been worn out at the end next to the fire-box, by the particles of coal drawn in by the draft.

"Both engines have now the same fire-boxes with which they were turned out of the maker's shop, excepting about one foot of the lower part, which has been once renewed. The iron flues now in use, are those put in to replace the copper—never having been renewed, either in whole or in part. Altogether, we have in use eight locomotive engines, three built by Eastwick & Harrison, one by M. W. Baldwin, and four in our own shops at Hazleton.

"We have never used other fuel than anthracite coal, excepting for the purpose of kindling fires. The engines have been in use, during the season of navigation, from two years ago, (when the last were built,) up to the time of the oldest engines named above, and we have never renewed a fire-box or set of flues, except the repairs to the two engines named. As far, therefore, as our experience goes, anthracite coal for fuel is not so destructive to fire-boxes and flues as has been generally argued and supposed. We wear out two sets of grate bars in the same season's use of an engine.

As to the Character of the Road.—In starting from the Lehigh at Penn Haven, we had, while using a part of the Beaver Meadow road, an ascending grade, averaging 80 feet per mile, for five miles; then 140 feet per mile for one and three-fourths miles; then 60 feet for three and one-half miles, and then a grade of 12 feet per mile, for three and one-half miles, to the intersection of the various branches to the mines. In descending, as you will perceive, mostly by gravity, the coal fire remained entirely inactive, having no artificial draft, by fans or otherwise, except that caused by the exhaust steam; while in the ascending with a load of empty cars, equal to the whole power of the engine, the fire to generate the necessary steam must be stimulated to the most intense activity; thus making,

apparently, a far more unfavorable state of things for the use of coal, than on a road where the grades are more uniform, and in consequence, the fire acted upon by a more uniform draft.

"I am aware that it has been said, that coal might do for short roads, but that on long roads, the continuous intense action of the heat would destroy the fire-box and flues.

"Now it strikes me as absurd, to suppose that on a road of any length, a fire need be made more intensely hot, or that any part of the boiler could be more heated, than is necessary to drive an engine and full train up ten miles of such grades as are specified above, or that a continuous equable heat, for eight or ten hours, can be worse than continuing the same heat for an hour, then a moderate fire for an hour, and so on alternately, with the consequent expansion and contraction, and this continued day after day, for eight months, annually, during fifteen years.

"I have entered on this subject, perhaps, to a somewhat tedious length, my object being, to satisfy yourself and others, that anthracite coal has been used, successfully, for a series of years, in this region, as fuel for locomotive engines not differing materially from the ordinary mode of construction."

The *New Bedford Mercury* gives an interesting account of an experiment, which has recently been made, under the direction of Wm. A. Crocker, President of the Taunton Branch Railroad, and S. M. Felton, President of the Philadelphia and Baltimore Railroad, for the purpose of thoroughly testing the feasibility of using anthracite coal in locomotives. For this purpose, they had an engine built at Taunton, in the most thorough manner, and it has been run, for about two months, on the Taunton and New Bedford Railroad, without losing a minute in time. It was then taken to the Worcester and Western roads, for further experiment. On the first trial on the Worcester road, towards the conclusion of the trip, owing to the want of skill in the fireman, the engine was behind time at Worcester, but then rallied, and went over the Western road to Springfield, losing only nine minutes. The engine then ran, for several days, between Springfield and Worcester, taking the usual heavy freight trains. On the 13th of October, it ran from Springfield to Worcester, taking the accommodation train, and arrived in good time, making an average of 28.6 miles per hour. On the same day, returning, it took the Albany express train to Springfield in 1 hour and 18 3-4 minutes, averaging 42 miles per hour. As a further specimen of its performances, the *Mercury* states, that it ran over a heavy, continuous grade of 11 miles, on the Western Railroad, taking it in 17 minutes, and having 100 lbs. of steam upon the summit. Of the peculiarity in the construction of this engine, and the economy in its use, the *Mercury* says:—

"The peculiarity of this locomotive consists in the construction of the boiler. To state this plainly, we may say that the water comes to the fire, instead of the fire going to the water. This passes through the tubes, instead of the fire, as in locomotives of the old construction, and is con-

tinually circulating about the fire-box. In this way, a moderate combustion generates the necessary amount of steam, and the fire-box not being subjected to that violent heat, which has been the real difficulty with other engines for burning anthracite, is preserved, while it has been burned out in all other engines in a few weeks.

"The economy of anthracite engines is now in process of proof by parties interested, and the result will doubtless be given to the public. Mr. Cummings, the engineer of the Anthracite, informs us, that for its day's work, of eighty-four miles, it requires 3,500 lbs. of coal, being kept standing upon its fire about two hours and a half, in New Bedford.

"Besides economy, there are several other considerations which should recommend the coal engines. Smoke, dust and cinders are all avoided. This not only adds greatly to the comfort of the passengers, but wood standing upon land adjacent to the road, is not in danger of fire, which, in dry weather, is often communicated by sparks from the ordinary engine."

RAILROAD AND STEAMBOAT ACCIDENTS COMPARED.

From a record of all the railroad and steamboat accidents, for a period of fourteen and a half consecutive months, ending March, 1854, the following results have been obtained: The whole number of railroad accidents was 190; killed, 268; wounded, 624. The whole number of steamboat accidents during the same period was 48; killed, 691; wounded, 225. It would thus appear that in the above-mentioned time, the number of accidents upon railroads has been 396 per cent. in advance of those upon steamboats. The number of wounded upon railroads has been 270.07 per cent. in advance of those from steamboat accidents, while the number of deaths resulting from steamboat accidents is 260.50 per cent. more than upon railroads. From this it would appear that railroad travelling is more prolific in accidents, but less serious in deaths, than steamboat travelling.

WETHERED'S IMPROVEMENT IN THE APPLICATION OF STEAM.

The principle of this improvement is very simple, and is neither new in its application nor construction, a similar contrivance having been used with success at Lowell some years since, under the direction of Dr. A. A. Hayes, of Boston. As it has attracted considerable attention during the past year, we copy the following published statement:—

The purpose sought to be attained is, an augmentation of the propelling power of the steam, by combining it with another current of steam which has previously traversed the highly heated atmosphere of the boilers, and thus raising it to a higher temperature.

To arrive at this result, the steam, as it escapes from the boiler, is concentrated in the conducting pipe, whence it is taken by two other pipes which, dividing it into two portions, lead it off in different directions—one directly into the steam-chest, and the other, by an interior chimney, through

the boilers, and in its turn into the steam-chest, after becoming super-heated. When the two portions reunite, the combined steam is at a very high temperature—some four hundred degrees higher than usual. The movement is given to the engine in the ordinary way, but with a vastly increased force.

A series of experiments, made under the direction of Mr. Collins, is said to have established the economy of this process, in respect to fuel—the savings in which is said to be about 70 per cent. By burning six hundred and sixty-six pounds of coal an hour, the simple steam gives nineteen and three-tenths double strokes of the piston per minute; whereas the combined steam gives twenty and one-tenth, with four hundred and forty pounds of coal only.

The *Journal of the Franklin Institute* for April, 1854, contains a report from Mr. Isherwood, Chief Engineer United States Navy, on the proposed new plan of Messrs. Wethered. The claim in the patent obtained by them, reads as follows: "*What we claim as new is, the combining steam, and super-heated, or surcharged steam for actuating engines, when generated, the elasticity increased, and operated as set forth.*" From this claim, says Mr. Isherwood, it will be seen, that the patent does not intend the use of steam simply surcharged by heat; that is to say, having a higher temperature than is normal to the same pressure of saturated, or ordinary steam; but it intends the use of *a mixture of saturated and surcharged steam.* I prefer these terms of saturated and surcharged steam to those of hydrous and anhydrous steam, or to those of steam and stame, because they are proper and their meaning already understood; ordinary steam being saturated with water, or of maximum density for the pressure; and surcharged steam being ordinary steam surcharged with heat, having less than the maximum density for the pressure, and therefore not being saturated with water.

The idea of the patentee is, that if a certain quantity of saturated steam be withdrawn from the boiler, and heated (out of contact with water) to a high abnormal temperature, then mixed with a certain quantity of saturated steam, and this mixture used to actuate the engine, a greater power can be derived from it with a given weight of fuel than could be derived from the use of saturated steam alone, generated by the same weight of fuel.

The mode of obtaining the "mixture" for practical use is very simple, and as follows, viz.: from the steam-chimney, or drum of the boiler, an usual steam-pipe, furnished with the necessary stop-valves, conveys externally from the boiler, the saturated steam to the valve-chest; another similar pipe, with stop-valves, etc., from the same steam-chimney or drum, but starting within the smoke-chimney, conveys saturated steam down the smoke-chimney, through the flues and through the furnaces, passing immediately over the incandescent fuel, and then having become highly surcharged in its passage, it is led out of the front of the boiler to the same valve-chest, where it is mixed with the saturated steam. From the valve-

chest the mixture passes to the cylinder of the engine, and actuates the piston in the usual manner.

The results attained to by Mr. Isherwood, in a series of experiments, were briefly as follows:—

Using the steam simply surcharged, produced, with the same fuel, an increased effect of sixty-five per cent. over what was obtained with the saturated, or ordinary steam alone; while an increased effect of one hundred and six per cent. was produced by the use of the mixture. Also, the increased effect of the mixture was twenty-five per cent. over what was obtained from the surcharged steam alone.

NEW PLAN FOR USING STEAM EXPANSIVELY.

Mr. B. F. Day has presented to the Franklin Institute, a plan of an engine for using steam expansively in a second cylinder. The difference between this engine and others operating on the same principle that have preceded it, is in contradistinction from allowing the steam to pass directly from one cylinder to another; the taking of the steam from the receiving cylinder to steam-chests provided with valves and posts, by and through which the steam is admitted to, and exhausted from, the second cylinder, by which means it is claimed, that a longer expansive action of the steam is retained. Another difference consists in surrounding the second cylinder, when used in connection with a receiving cylinder, with a flue, through which the unconsumed combustible gases are passed after leaving the furnace, by which any loss from radiation will be avoided, and the steam in the cylinders will, to some extent, be reached by caloric.

ON BOILER EXPLOSIONS.

At the British Association, a communication on boiler explosions gave rise to a discussion on the causes of such explosions, and on the effect of percussion in weakening the strength of iron, in which Mr. Fairbairn, Mr. Roberts, Mr. Hopkinson, Mr. Oldham, and other members took part. Mr. Fairbairn said, that, so far as his experience went, the explosions of boilers generally occur at the moment the engines start, in consequence of the sudden generation of steam by the increased motion given to the water. With respect to the weakening of railway axles by use, he conceived that effect to be produced rather by the continuous bindings of the metal, however small they may be, which give a set to the fibres and increase the liability to break. Boiler-plates are also frequently injured by the operation of punching for melting. Mr. Roberts attributed boiler explosions in most instances to the defective construction. He was of opinion that in riveting boiler-plates the rivets are seldom made large enough, large rivets being much stronger than small ones. Mr. Clay said the crystalline structure of wrought iron acquired by long continued percussion might be restored to the fibrous state by reheating. Mr. Oldham

considered it would be of advantage to reheat the axletrees of locomotive engines after they had run for some time, so that the fibrous structure, from whatever cause it was rendered crystalline, might be restored. Mr. Roberts was not disposed to admit that any change is produced in the quality of iron by wear. If the iron were of good quality and perfect at first it would remain so till it was worn out. He observed that bars of iron are frequently different at their opposite ends, for whilst one is tough the other may sometimes be broken with a slight stroke of the hammer.

NEW METHOD OF ADJUSTING VALVES OF LOCOMOTIVES.

H. W. Farley of East Boston, has invented a method of setting the valves of locomotives, which is at the same time cheap, simple, and very economical of time, space, and manual power. The invention applies only to the method of obtaining a rotary motion for the wheels. The setting of the valves correctly, is a matter of vital importance, and it is necessary in its accomplishment to revolve the wheels many times. This is usually done by moving the locomotive along on the track, a method quite inconvenient on account of the space required in the shop. Mr. Farley places a suitable shaft just beneath the floor, on which shaft are two wheels, at distances corresponding to the gauge of the track. The rail being cut away at that point, these rollers are placed with their upper surfaces flush with the top of the rail, and by so locating the locomotive that the driving-wheels rest on that point, any desired motion may be given by rotating the shaft. For engines with a single pair of driving-wheels, the operation is exceedingly simple, but when (as is now almost universally the case) two pairs are coupled together, either the side rods are to be disconnected or the hinder pair lifted so as to turn clear of the rails.

IMPROVED STEAM COCK.

Mr. O. C. Phelps of Boston, is the inventor of a cock designed to take the place of the ordinary ones in almost every situation where considerable pressure is experienced. The objcct is to compel the pressure of the fluid to keep the device always tight. In passing through this cock the fluid, whether steam, water, or gas, turns a right angle, and the axis of the plug is in line with that part of the pipe through which the fluid is received. The plug is conical and partially hollow, the larger and hollow end being preserved for the reception of the fluid, which is of course discharged through a hole in the side. From this description it will be evident that the plug must be inserted from the inside, the stem to which the handle is attached being merely a continuation of the smaller end. This invention appears to be particularly applicable as test cocks in high-pressure boilers.

ON THE EMPLOYMENT OF SAL AMMONIAC TO PREVENT INCRUSTATIONS IN STEAM-BOILERS.

The employment of sal ammoniac to prevent incrustations in steam-boilers, to remove them when formed, has formed the subject of a series of experiments undertaken by M. Conrad, Director of the corps of engineers, Holland. In his report, he says: The experiments which have been tried on locomotives on the Holland railways, have demonstrated that it is an excellent means to detach and dissolve the calcareous incrustations of boilers, and dispose of them so far that the boilers may be completely rid of them. To prove this, there was introduced 60 grammes (a French gramme is the one-thousandth part of a kilogramme, or 2.2 pounds) of sal ammoniac in powder into a boiler, immediately after being filled with water. This was left until the evening of the next day, after the locomotive had done its service. The boiler being found not dirty, it was run still another day, at the end of which it was emptied, and the boiler appeared perfectly clean. The water taken out was generally, in proportion to the calcareous matters contained in the boiler, a solution more or less saturated with sal ammoniac and lime, which amounted to one eight-hundredth the weight of the solution. Later, there were formed paillettes of lime, which easily passed off by the discharge-cocks. After the boiler had thus been, during fifteen days or a month, purged of incrustations, it sufficed to introduce once or twice per week, 60 grammes of the salt, to keep it entirely clean. A more attentive examination showed that the water, after one or two days of service, did not give a single trace of iron or copper in solution.

It is certain, then, that the quantity of salt indicated cannot in the least shorten the duration of the boiler; but, on the contrary, may augment that of the fire-box and tubes, by preventing destructive incrustations; and it also decreases the quantity of combustion, as the incrustations are very bad conductors of heat. Again, the decreased quantity of fuel used tends of course to make the boiler last longer. It is probable that the sal ammoniac, in combining with the lime, forms chlorhydrate of lime, and that by this combination the ammonia is set free; at least, this is what is conjectured by the odor of the steam.

Report of M. C. Scheffer.—" At the commencement of the year 1847, experiments were undertaken on the steam-boiler at the royal saw-manufactory of Rotterdam with sal ammoniac, to ascertain to what point they could succeed by this means to prevent the injurious effects of incrustations on the sides of this boiler. This boiler is low-pressure, the tension of the steam being scarcely one-tenth of an atmosphere above the ordinary atmospheric pressure, and puts in movement a machine of sixteen-horse power, of Maudslay's. The water employed is that of the Meuse, which according to the analysis of M. Muller, contains much calcareous matter. From the 26th March there were introduced, three times a week, 100

grammes of sal ammoniac into this boiler, after having been cleaned of all previous incrustations. Four months afterward, I submitted to an examination the sides of this boiler, and I found a tolerably regular accumulation of incrustations on the vertical sides, while above the furnace this crust was much less. Its thickness was evidently less everywhere than usual, and nevertheless, during all this period, it had been heated on the average 14 hours per day. The boiler was cleaned anew, and about 45 pounds of incrustations removed. I at once commenced a new trial, and as I did not know exactly the proportion of salt necessary to completely prevent the evil, I resolved to double the former trial, and to use 200 grammes, which was thrown twice a week into the boiler. After more than five months of work, there were still some incrustations, and principally, as in the first trial, on the vertical sides; but the experiments go to show that, by the use of this salt, incrustations may be very much diminished, and perhaps totally prevented, and it is of great importance to pursue these experiments further."

The following is for the most part an abstract of a recently published work by Dr. Elsner, German :—

On the means hitherto employed in preventing the production of scale in steam-boilers, with the addition of some original observations upon this subject.

Potatoes.—Of these, one-fiftieth of the weight of the water is said to be sufficient to prevent the incrustation. According to Elsner, crusts already formed are not removed by potatoes. The action is mechanical; the calcareous particles, when separated, becoming coated with the slimy matter of the potatoes, which prevents their forming a coherent deposit.

Fatty Oils, Tallow.—Oil, when poured into the water, is said to prevent incrustation. According to Kennedy, the inside of the boiler should be well rubbed with a mixture of three parts of black lead and eighteen parts of tallow. Newton recommends one part of tallow, one part of black lead, and one-eighth part of powdered charcoal. The statements as to the degree of protection afforded by this agent are satisfactory.

Sawdust.—A patent was obtained in this country about eight years ago, for the exclusive use of mahogany sawdust introduced into the boiler. Indian meal introduced into the boiler has also been tried with success. Ira Hill replaced the mahogany dust by oak dust, and any other wood will serve equally well. The disadvantages of this prevention is the readiness with which the sawdust may be carried into the pipes, cocks, valves, etc., where it might produce evil consequences. The action of the sawdust is also mechanical.

Clay, free from sand, and worked up with water, is recommended by Chaix. Aldefeld found that this agent prevented the formation of scale; but that, on the other hand, it produced a slimy coating in the pipes, and rendered the steam cylinder rough. Its action is also mechanical.

Ammoniacal Compounds.—Ritterbrand, in 1844, patented certain ammoniacal compounds, especially muriate of ammonia. Elsner regards this

proposition as the most deserving of notice. As much muriate of ammonia is added to the water as it contains carbonate of lime in solution. This agent also softens old incrustations, but for this purpose something more than the quantity just mentioned is required. Its action is chemical; from the muriate of ammonia and sulphate or carbonate of lime, are formed chloride of calcium and sulphate or carbonate of ammonia. The latter salt is somewhat volatile; if the steam is to be employed in heating color baths, it is necessary to ascertain whether the volatile alkali will have an injurious action. Elsner states that one pound of muriate of ammonia is sufficient for twenty cubic feet of well-water containing gypsum. Muriate of ammonia is preferable to carbonate of ammonia. In the *Verhandlungen des Hollandischen Ingenieurvereins*, there are two papers on the employment of muriate of ammonia. The first, by A. A. C. de Vries-Robbe, shows, that in the locomotives on the Dutch railways two ounces of muriate of ammonia for each boiler is sufficient to clean incrusted boilers in a few days. This quantity, put in twice a week, keeps the boiler quite clean; iron and copper are not dissolved by it. The second paper, by C. Scheffer, states that in the royal wood-cutting establishment of Holland, a perfectly clean boiler was supplied weekly for four months with two-tenths of a pound of muriate of ammonia, when forty pounds of scale were found to have been deposited. The boiler was worked fourteen hours daily, with water containing gypsum.

With the addition of four-tenths of a pound of muriate of ammonia twice a week for five months, with the same amount of daily work and the same water, sixty pounds of scale had deposited. In both cases, the deposit was more upon the sides than upon the bottom of the boiler, and much less than without the use of sal ammoniac.

Mixture of Extract of Tannin.—J. Delfosse patented a mixture of twelve parts chloride of sodium, two and one-half parts caustic soda, one-eighth extract of oak bark, one-half of potash, for the boilers of stationary and locomotive engines. The principal agent in this appears to be the tannin of the extract of oak bark. Elsner recommends the roughly cut root of the common tormentil for this purpose, on account of the large quantity of tannic acid it contains.

A patented process is now in use in England, which must be mentioned here. Spent tanner's bark is put into the boiler. To avoid the chance of the bad result already referred to with the sawdust, the bark is put into a perforated vessel, which is suspended near the surface of the water, and kept in the right position by means of a float. The bark is renewed from time to time. The patentee supplies the whole apparatus for about £2 10*s*, and publishes many testimonials to show that his process is perfectly successful.

According to Cave, pieces of oak wood, suspended in the boiler and renewed monthly, prevent all deposit even from waters containing a large quantity lime. The action must depend principally upon the tannic acid.

Starch-Sugar, Molasses, Syrup.—Gunion put into a boiler, seventeen and a half feet long, and three and a half feet in diameter, five kilogrammes of molasses every two months; he found that this completely prevented incrustation.

Guimet proved the advantage of this process, but employed brown starch syrup, three pounds every six months for a boiler of eight-horse power.

Tin salt (chloride of tin) is recommended by Delandre; it is similar in its action to muriate of ammonia; but as it is cheaper it is to be preferred.

Soda and potash have been recommended by Kuhlmann, and more recently by Fresenius. According to the latter, the property of forming crust occurs more with water containing gypsum than with that containing chalk.

Kuhlmann recommended the addition of 100 to 130 grms. of soda monthly, to every horse-power with water containing sulphate of lime. Elsner observes that too much soda might injure the solderings and joints. Zimmer, of Frankfort, who long employed this method, found that the boiler was strongly acted upon; he ascribes this to the presence in almost all sodas of cyanide of sodium, which possesses the power of dissolving iron.—*Scientific American.*

NEW FORM OF SUSPENSION BRIDGE.

At a recent meeting of the Franklin Institute, Mr. William Reed exhibited a model of an improved form of suspension bridge. He forms a hollow, truss-beam of plate iron, with cast-iron ends the whole length of the span. In this, the wire is suspended from the upper end of each extremity, and passing towards the lower margin, near the centre, the cable and tube being well supported by truss braces, which effect the double purpose of bringing the weight of the truss, and the superstructure of the span, on to the cables, and holding the truss-beam in proper shape, acting as the ribs to a vessel. The height of the truss-beam, and the thickness of the iron of which it is made, are to be governed by the length of the span. The upper part of the truss-beam must contain sufficient material, to resist the compression of the superstructure and load, and the two feet of the lower edge of the truss-beams, with the cables, are to support the whole tension. Where the span is long, and breadth of beam is required, in order to save material, the top, and two feet of the lower edge of the beam, may be made of plate iron, and the intermediate space filled in with wrought iron bars, riveted from the top to the bottom, crossing each other, forming a lattice so as to preserve the stiffness of the tube or beam. Where footways are wanted, the floor-beams can be extended out for that purpose. By this arrangement, the whole amount of the tension of the wire can be obtained, while the peculiar form of the truss-beam will cause any weight that may be brought on any part of the bridge, to communicate to all parts of the span.

IMPROVEMENT IN COMMUNICATING ROTARY MOTION.

At a recent meeting of the Franklin Institute, Mr. Jones called the attention of the members to a simple contrivance for communicating rotary motion, without the aid of toothed wheels, or belts, invented by Mr. Joseph Thatcher, of Philadelphia. It is believed to be new, and consists of a rigid bar whose ends are fitted to the pins of cranks secured on the shafts that are intended to transmit and receive the motion. In the middle of the bar is a slotted hole, of a length rather more than the throw of the cranks. A stationary pin is secured in line with the centres of the two shafts, and (in the present instance) equi-distant from them. Upon this pin the slotted lever is free to slide, in the direction of its length. When one shaft is turned from right to left, the crank pin carries the attached end of the bar with it; the fixed pin in the slotted hole, preventing any motion sideways, the other end of the bar is obliged to move in an opposite direction, or from left to right; the motion of the bar gradually changes from a vibratory, to one in the direction of its lengths, and *vice versa*. The model shown worked freely, no undue friction being apparent.—*Jour. Frank. Institute*, August, 1854.

REMOVAL OF THE WRECK OF THE UNITED STATES FRIGATE MISSOURI, AT GIBRALTAR.

One of the most difficult, and at the same time successful, sub-marine operations ever undertaken, was the removal of the wreck of the U. S. Steam Frigate Missouri, which was burned and sunk some years since, in the harbor of Gibraltar. She careened as she went down, and laying upon her beam ends, presented one of her shafts upwards, very near the surface of the water. This mass of iron was 19 inches in diameter, and of course, offered a dangerous obstruction to the bay. The existence, moreover, of so vast a body as the sunken frigate, at the bottom of a harbor in which the tides ebbed and flowed, and strong currents continually shifted the sand, was not to be tolerated in a port, so important to the commercial and war marine of Britain, as was Gibraltar. The British government accordingly presented the case to the cabinet at Washington, and requested the removal of the obstruction. This was at once agreed to by the authorities at Washington. The British Secretary, conceiving the job to be a very bad one, kindly recommended to our government, as very suitable engineers of the work, Messrs. Lovi and Marshall. These gentlemen had acquired a great reputation in England, by raising the line-of-battle-ship, the Royal George, which sank so suddenly, at Spithead, and carried down with her hundreds of men and women. Our Navy Department employed these engineers to raise the Missouri. They went to Gibraltar, and worked faithfully for three long years, at the noble hulk under water—and then reported to the Department at Washington, that

the Missouri could not be raised by human means. They abandoned the enterprise and returned to England.

The necessities of the case induced Mr. Webster to take hold of the matter, and find a man who would free Gibraltar harbor of that obstruction. He applied to Mr. John E. Gowen, of Boston. When asked by the Secretary, if he could remove the wreck of the frigate, as she lay there in forty-one feet of water, he said he could. When asked if he would enter into $50,000 bonds for the performance of a contract to raise her, he said he would. When asked if he would bind himself to have every stick of the frigate out of the way within three years, he said he would bind himself to accomplish it within six months. A contract was immediately made. Mr. Gowen was already equipped with his submarine armor. The removing apparatus remained for him to construct. On reflecting, he decided to blow the frigate to pieces, and lift and remove the fragments in detail.

The case, on full inquiry and investigation, proved to be one of peculiar difficulty. The sand had accumulated upon the wreck. It was fifteen feet over her. Moreover, the English engineers had hurt the job, and made it much more difficult, by using vast quantities of powder at random, among the engines and iron work. They had twisted and tangled up the machinery badly. Above the fifteen feet of accumulated sand, was a depth of twenty-sixt feet of water to work through.

Mr. Gowen devised metal cases, to contain his charges of powder, and which, of course, had to be placed under the frigate's bottom, and through that fifteen feet of sand. These cases were of cast-iron, six feet long, fourteen inches in diameter, and held a charge of two hundred and fifty pounds of powder. At the conical end was a large thread, like that about a post auger, cast on the case, and to be used in boring into the sand as with an auger. This lower end was cast in a chill, and was so hard and strong, that it stood, in one instance, the test of being bored through a McAdam Street, six feet into the earth. Mr. Gowen took out with him twenty-four of these iron powder cylinders. He used only twelve of them. His divers descended in their armor, pointed the cylinders properly; these were turned by shafts worked from above, and when located under the vessel's bottom, were fired by an electric battery.

The quantity of 43,000 pounds of powder was consumed in the work. Of this, full two-thirds were used in blowing off the iron centres and arms from the shaft. She was a side-wheel steamer, and had upon each of the outboard shafts 96 iron arms, which weighed 350 pounds a piece. To break up this complicated mass of powerful iron work, and reduce so as to be lifted, was really the labor to be accomplished. But the work was accomplished, and the utmost stick, and the last visible spike of this great steamer was taken up and carried away. Nothing was left for the sand to form a bar upon, and five months from the day Mr. Gowen began the work, he fully completed and performed his contract. About 1,600 tons of iron was raised, with a large number of oysters that had attached them-

selves to the wreck. The iron, by the action of the sea-water, was nearly worthless. The arrangement of the submarine apparatus employed was so perfect, that no accident of any description, occurred to any of the divers during the prosecution of the work, the men frequently remaining under water for twelve hours.

ON THE CONSTRUCTION OF WATER-METERS.

The following paper on the theory and construction of water-meters, was recently presented to the Society of Arts, London, by Mr. J. Glynn, F. R. S. After alluding to the necessity for some correct measurer of water, now that there was a very general demand for the constant supply system, the author described what he thought were the essentials of a good water-meter. These were, 1. That it should correctly measure and show the quantity of water delivered under varying heads or pressures; 2. That it should not be liable to get out of order; 3. That it should be easily cleaned, oiled, or adjusted; and 4. That the cost be not too great, so that it may be generally used by householders. The majority of those hitherto invented had, he considered, been deficient in one or more of these essentials, and the Jury of the Great Exhibition did not award even honorable mention to any meter, though five different contrivances were exhibited there. He then explained the leading features of the several plans which had been proposed, commencing with the double cistern, to be emptied and filled by turns, the contents of which being known, and the ebb and flow of the water registered, a very simple and compact meter for water delivered in large quantities, at a low pressure, might thus be made. The same idea of twin vessels and a reciprocating action by means of a diaphragm, or flexible partition, had been further elaborated, something like the gas meter upon that principle. The reciprocating motion of a piston in a cylinder like that of a steam-engine had also been proposed, but some head of water was required to overcome the friction of the mechanism in this case. Other forms of the steam-engine had also been suggested, such as the disc-engine, which combined the rotary with the reciprocating action. The water-wheel on a small scale, and revolving in a circular case, had been tried in various ways, and was a favorite scheme, but not a successful one. The clepsydra, or water-clock, had also been tried to measure water; and after this came drums of many shapes, some receiving the water at their centre, others at their circumference. Of those taking the water at the centre, some resembled a fan blast, some were like Appold's pump, and one was like Barker's mill, which had ingenious contrivances for obviating friction, for continual lubrication, for straining the water as it entered, and for preventing acceleration of the drum or *mill part* of the machine, for which Mr. Siemens had a patent. Another type was the insertion in a pipe of something like a screw-propeller, which would register at the *rate* at which the water flowed past; and there were modifications of it in portions of screws, drums with spiral vanes, and so forth. Mr. Siemens had a patent

of this kind, in which two or three spirals revolved in opposite ways to prevent acceleration. The author then described a meter invented by Mr. Chadwick, of Salford, which had recently been brought under his notice, and which it was stated only varied five per cent. between a head of water of one foot and one of 300 feet. In this meter a wire gauge or sieve was introduced between the supply pipe and two inlet passages situated in the bottom of a cylindrical vessel. These passages opened into two vulcanized India rubber bags, which were bedded and laid flat on the bottom of the vessel, and there were openings at the other extremities of the bags for allowing of the exit of the water into the meter. On the water entering these bags it set in motion three conical rollers attached to a central spindle in connection with the ordinary counting wheels and dial, each revolution of the rollers, registering exactly the contents of the bags. About two years ago the Corporation of Manchester advertised for a water-meter capable of measuring correctly under variable and great pressure. This was responded to by a large number of persons, and among others by Mr. Taylor, who had had his attention for some time previously directed to the subject. His meter consists of a cylindrical vessel or cistern, of a size proportioned to the bore of the pipe that was to receive and discharge the water. Inside the above-mentioned vessel there was a drum revolving on its axis in a vertical or upright position, and the stream passing through the meter was distributed upon the drum at each side of the meter. The registration was given by a train of wheels connected with the drum, and carried to the indicator. The first meter made on this principle was fixed up at the extensive cotton mills of Messrs. Birley, Manchester, and had been working almost a year and a half without the slightest disarrangement, measuring from 35,000 to 36,000 gallons per day. There was one with a twelve-inch bore pipe now working, measuring the water supplied by the Corporation of Manchester to the township of Dukinfield, to the satisfaction of both parties concerned; and there were as many as betwixt one and two hundred meters working in various parts of the country.

IRON COFFER DAM.

In a report of the proceedings of a semi-annual meeting of the Cornwall Railway Company, in England, embracing the report of Mr. Brunnel, the Engineer, on the works of the Saltash Bridge, on a part of the line of unfinished railway between Truro and St. Anstell, we find a description of a coffer dam of a novel construction, sunk in a very deep part of the river, to facilitate the construction of a pier for the support of the centre of the bridge which forms a necessary part of the line. The dam in question is not only of a novel structure, but it is made to shut out water to a greater depth than any other work for a similar purpose that we have before seen any account of, viz.: a pressure, under high tides, of 70 to 80 feet. It is so constructed as to act on the principle of the diving-bell, in case the water should find its way into the inclosure. But it seems to have thus

far served its purpose, without a resort to this apparatus. The structure is thus described :—

It consists of an iron cylinder 37 feet in diameter and 85 in height, containing, within itself all the arrangements of air chambers, passages, etc., necessary for using it either as a large diving-bell or simply as a coffer dam, as circumstances might require, and so constructed as to be afterwards divided into two parts vertically, and removed after the pier shall have been built within it. The whole, weighing upwards of three hundred tons, was safely launched and floated into place, where it was raised perpendicularly, and pitched upon its lower edge in the centre of the river. The river is at this point upwards of 50 feet deep at low water of neap tides, and except for a short space on the turn of the tide, there is a considerable current; under such circumstances, this cylinder, drawing 50 feet of water, was pitched upon its lower edge accurately—that is, within three or four inches of the exact point required. Since then the work has been carried on at the bottom of the cylinder, as in a diving-bell, against a pressure of water occasionally of 70 and 80 feet. The mud and other deposits forming the bed of the river for 10 feet or 12 feet in thickness, have been removed, and the cylinder is now resting on the rock, and preparations are making for excavating the rock into level beds for receiving the masonry.

ACTION OF SEA-WATER ON CEMENTS.

M. M. Malaguti and Durocher, have lately devoted much attention to the action of sea-water on hydraulic cements, and have discovered that "Parker's," which contains a considerable portion of the oxide of iron, stands the best. They formed several kinds of puzzolanas by making mixtures of silica and a little lime with alumina and oxide of iron, and then studied the action of sea-water on these mixtures, previously heated to a dull redness. After immersion for some time, these substances augmented in volume, and possessed the most remarkable characters. Each of them divided itself into two distinct compounds, one of which attached itself to the bottom of the flask, and had gained considerable cohesion and adherence; whilst the other assumed a flocculent aspect; it swelled out more and more, and rose above the bottom. In analyzing these different compounds, they have found that the quantity of lime precipitated is independent of the presence of alumina, whilst it is augmented by the presence of oxide of iron. Further, they have recognized that the flocculent compound was the richest in alumina, and that the concreted deposit was richest in oxide of iron.

These synthetical experiments having apparently demonstrated that oxide of iron is not an inert constitutent of hydraulic cements; they believe that the presence of this oxide would contribute to give stability to mortars and cements immersed in sea-water. It remains, however, to be ascertained whether cements or artificial hydraulic limes, formed by the addition of

lime to ferruginous clays, or mixtures of clay with hydrated peroxide of iron, or even mixtures of clay and substances capable of generating oxide of iron, will not be attacked by sea-water. But these experiments require a considerable time, and in the meantime, it may do good to give publicity to the results which they have obtained, as they may be useful to those engaged in the construction of hydraulic works, and because it is of the greatest importance that they should be verified by experience.

ON THE FATIGUE OR CONSEQUENT FRACTURE OF METALS.

At a recent meeting of the Institution of Civil Engineers, a paper was read on the above subject, by Mr. Braithwaite, C. E.

Many accidents, the causes of which have been pronounced "mysterious," having professionally engaged the author's attention, he had carefully examined the circumstances of each, and the condition of the fractured metal, in all cases, and at length arrived at the conclusion, that almost all the accidents might be ascribed to a progressive deteriorating action, which might be termed the "*fatigue of metals.*"

Metal in a state of rest, although sustaining a heavy pressure or strain, as in a beam, or girder, and exhibiting only the deflexion due to the superposed weight, would continue to bear that pressure without fracture, so long as its rest was not disturbed, and the same strain was not too frequently repeated. But if either of these cases occurred, a certain disturbance of the particles took place; the metal was deteriorated, and that portion subject to the reiterated strain was so far destroyed that it ultimately broke down. This might also arise from sudden concussions, when the metal was under a certain strain, and those concussions might be caused by the girder being suddenly unloaded. Several examples were given of accidents of the kind that had been alluded to; for instance that of a vat in a London brewery, carried on cast-iron girders, by which it had been supported for some years; but suddenly, without any apparent cause, they broke, and killed and wounded some workmen. In this case it was shown that the girders were not sufficiently strong for the load, and therefore, the intermittent load of the vat, which was sometimes full, and sometimes empty, caused a constantly recurring deflexion, and a subsequent corresponding effort to regain its natural position, by which the composition of the metal was disturbed, and fracture ensued. Other examples of the same nature were given, and it was shown that the repeated buckling of the tube-plate of a locomotive, arising from the action of the pistons, had a tendency to cause fracture mechanically, and also that the side strains and vibrations to which suspension-rods of the ash-pans of locomotives were subjected, had produced very serious results, which it sufficed to point out forcibly to guard against the recurrence of.

The author contended, that presuming adequate dimensions to have been given to girders, and the stipulated weight not to have been exceeded,

the chances of accident were remote; but that any repeated deflexion, either at intervals, or continued so long as to induce a permanent depression, must be productive of danger, which could only be adverted by altering, or replacing the parts deficient in strength, and maintaining a rigid supervision, whether of beams when loaded, or of parts of machinery, or of railway stock after working. By such means, accidents would be prevented, and a greater degree of confidence be established in structures in which metal was employed.—*Lond. Mechanics' Magazine.*

DILATATION OF CAST-IRON BY SUCCESSIVE HEATINGS.

The remarkable phenomenon that cast iron presents after being heated, of not returning, on cooling, to its original dimensions, but of presenting constantly an increase of this volume, and by consecutive heatings and coolings, of acquiring a permanent volume, larger and larger, was first observed by Prinsep, in 1829. This chemist found that a retort of cast-iron, of which the capacity had been measured with care by the weight of mercury it contained, gave the following results. Before ever being heated, the retort contained 9.13 cubic inches of mercury; after the first heating and cooling, the contents were increased to 9.64 cubic inches; and after three successive heatings to the fusing point of silver, the contents were 10.16 cubic inches. The cubic dilatation produced then was 11.28 per cent., or a lineal dilatation of nearly 3.73 per 100. Since this, there has been occasion to observe more frequently, and to investigate this property of cast-iron. It has been remarked, in effect, that all grate-bars which sustained a high heat became curved, little by little, that they elongated more and more, until finally they would push out the bars that sustained them.

M. Brix, in a work he has recently published, entitled *Researches on the Calorific Power of the Principal Combustibles found in Prussia*, has made known some experiments on this subject. By the aid of numerous measurements, he has found that its permanent length augments after a heating, but that this augmentation was so much the less as the bar had been heated more often, and finally ceased. Thus, a grate-bar of 3.5 feet in length, after three days of a moderate fire, had taken a permanent elongation of three-sixteenths of an inch, (equal to 0.446 per cent.;) at the end of seventeen days, this elongation was seven-sixteenths of an inch, (1.042 per cent,) and at the end of thirty days had reached thirteen-sixteenths of an inch, (nearly two per cent.,) and did not yet appear to have attained its maximum. Another bar, of the same kind, after a long service, had preserved a permanent elongation of 1.25 inches, or nearly three per cent. The bars, while in the fire, experience another elongation, which is temporary, and contract as the heat is diminished; and it may hence be concluded with M. Brix, that it is proper to give to each new bar a play, longitudinally, of about one twenty-fifth of an inch, or four per cent., to allow for this permanent and temporary elongation. In all cases,

it is necessary to make it long enough, that when cold it may not fall between the supports, but in general it seems that not sufficient play is given to bars supported in this manner.—*Technologiste*, May, 1854.

MANUFACTURE OF IRON FOR SHIP-BUILDING.

Robert M. Garvin, of Glasgow, has devised the following method for preventing the adhesion of barnacles, and other animal matters, or formations to the bottoms of iron ships when afloat. He accomplishes this end by adding to, or mixing in the iron, of which the ships are to be built, a small proportion of arsenic. This admixture may be effected, either when the iron is in a state of fusion, or at any other suitable or convenient stage in the manufacture of the metal, such as in the puddling or blooming processes, when the metal is soft and plastic.

The effect of such admixture with the iron is, that the resultant, gradual, feeble solution of the poisonous matter in the water, destroys, or prevents, the adhesion of all barnacles, and marine animal productions, of every kind; and thus no hold is afforded for the foreign matters which ordinarily cling to the fundamental animal formations.

By adding the poisonous matter to the mass of metal, during the process of the manufacture of such metal, the latter becomes thoroughly incorporated with the poisonous ingredient, so that the whole of the exposed iron of which a ship is built, retains its poisonous qualities until actually worn out, instead of losing such qualities by surface wear. In practice, it has been found necessary to add as much of the ordinary white or yellow arsenic of commerce as the iron will fairly receive, without suffering any deterioration in its quality. This necessary amount of arsenic varies from two to five per cent. of the iron, according as the quality of the latter varies. It is preferred, to effect the admixture of the poisonous matter in the puddling furnace, the addition being made just before the metal begins to boil; or, instead of this routine, the poisonous matter may be placed between the metal blocks, before the latter are heated for the rolling process. By pursuing this last plan, little or no loss of the arsenic ensues. The patentee also finds it necessary, to sprinkle the outside plate, whilst it is red hot, with a little arsenic in addition, the sprinkling to be performed before completing the rolling—as, for example, before the last two entrances to the rollers. The poisoned plates are then well cleansed with strong acid, and are scrubbed with holystone, and are immersed in a mixture of arsenic and spelter, tin, lead or zinc. It is obvious that this system of treatment is applicable to the metal employed in various details concerned in naval construction.

Iron plates treated in this way, have been tested by immersion in sea-water, as well as by building them into the hulls of sea-going ships, with the most favorable results.—*Mechanics' Journal, London.*

THE VALUE OF IRON.

To show how cheaply iron is obtained, and how the mechanical skill and labor expended upon it totally overshadow the price, a number of the *British Quarterly Review* gives the following curious and instructive calculation :—

Bar iron, worth £1 sterling, is worth, when worked into horse shoes, .	£2 10 0
Table knives, ...	36 0 0
Needles, ...	71 0 0
Penknife blades, ...	657 0 0
Polished buttons and buckles, ...	897 0 0
Balance springs of watches, ...	50,000 0 0
Cast iron, worth £1 sterling, is worth, when converted into machinery,	4 0 0
Larger ornamental work, ...	45 0 0
Buckles and Berlin work, ...	600 0 0
Neck chains, ...	1,386 0 0
Shirt buttons, ...	5,896 0 0

Thirty-one pounds of iron have been made into wire upwards of one hundred and eleven miles in length, and so fine was the fabric, that a part was converted, in lieu of horse-hair, into a barrister's wig. The process followed, to effect this extraordinary tenuity, consists of heating the iron, and passing it through rollers of eight inches diameter, going at the rate of four hundred revolutions per minute, down to No. 4 on the gauge. It is afterwards drawn cold, down to No. 38 on the same gauge, and so on, till it obtains the above length in miles.

COMPOSITION OF STEREOTYPE METAL.

Persoze, the French chemist, has published the following table, of various fusible alloys used in producing stereotypes :—

No.	Lead.	Tin.	Bismuth.	Antimony.	Character.
1	—	9.3	0.5	—	Hard and sonorous.
2	32.0	30.0	8.0	—	Fusible at 156 centigrades; somewhat soft, very malleable.
3	88.0	24.0	8 0	—	Fusible at 148 centigrades; harder than No. 2.
4	—	8.0	2 0	—	Fusible, very brittle and very hard.
5	16.0	24.0	8.0	—	Fusible at 150° centigrades, very hard and very malleable.
6	—	9.5	—	0.5	Hard, very malleable.
7	10.0	40.0	—	10.0	Very hard, very malleable, excellent, but less fusible.
8	—	9.5	0.29	0.29	Very hard and very malleable.
9	5.0	3.0	8.0	—	Very fusible, very good, but dear.
10	100.0	0.24	—	20.0	Less brittle than ordinary type metal.

ON THE COMPARATIVE STRENGTH OF LEAD AND TIN PIPE.

As the substitution of block tin pipe in place of lead, is rapidly taking place, for the conveyance of water, the following results of experiments instituted by Dr. W. H. Ellet, of New York, on the comparative strength of the two metals, to resist hydraulic pressure, will prove interesting. Dr. Ellet, in his report, says: For the purpose of determining the power of tin to resist pressure, absolutely, as well as relatively, to that of lead, I caused to be manufactured coils of pipe of the two metals, of precisely the same dimensions. They were made, by hydraulic pressure, with the same machine, the metals being urged through the same die, and passed over the same mandril. The interior diameter of these pipes, was five-eighths of an inch, the exterior seven-eighths, and their thickness was, of course, one-eighth of an inch. The lead pipe was tried first. A pressure of 50 lbs. to the square inch, was applied, without any sensible effect. The pressure was now gradually increased, and when it had risen to somewhere about 200 lbs. to the inch, the pipe began to swell uniformly. Continuing to increase the pressure, the dilatation increased likewise, until having reached a force of 397 lbs. to the inch, a sort of *aneurismal tumor* appeared at one point, where the metal rapidly thinned out, and at length parted, with a longitudinal fissure, having sharp edges. The dilatation in the rest of the pipe, had increased its diameter from seven-eighths of an inch to one and one-eighth.

The tin pipe was next put under trial. The initial pressure here was that at which the lead pipe had given way, viz.: 397 lbs. to the inch. On increasing the pressure rapidly, dilatation was not observed until the force employed was somewhere between 800 and 900 lbs. to the inch. The pipe burst at the pressure of 1,212 lbs. to the inch, presenting, at the point of rupture, precisely the same appearance as the lead had done. The general dilatation had increased the diameter, from seven-eighths of an inch to precisely one inch. These experiments show, most conclusively, that the *strength of tin pipe to resist internal pressure, is more than threefold that of lead.*

The greatest pressure on the distributing pipes of the Croton, in the city of New York, does not exceed 30 lbs. to the square inch.

IMPROVEMENTS IN THE MANUFACTURE OF IRON.

Mr. H. Leachman, of Islington, England, has patented an invention, which consists in treating iron by means of certain materials, or a certain combination of materials, for the purpose of producing more plastic and malleable iron than heretofore. For this purpose, common brick-dust, salt, black oxide of manganese, and pig-iron, are employed, as herein-after mentioned. The first three mentioned materials are mixed together, in the following proportions, that is to say: Common brick-dust, 120 lbs.; com-

mon salt, (pounded fine) 600 lbs.; black oxide of manganese, 280 lbs.= 1,000 lbs. These three materials are to be thoroughly intermingled, and reduced to a state of powder, and used in the boiling process to which pig-iron is usually subjected. When the metal is thoroughly melted, and commences to rise, the powder is to be added, in quantities varying from 4 lbs. to 10 lbs. weight, according to the quality of the metal. If the metal is of a very poor quality, 10 lbs. weight to the heat of 420 lbs. of metal, is used; and as the quality is superior, so less is to be used proportionally, up to 4 lbs., in doing which, the manufacturer must be guided by experience. The powder should be added to, or thrown into the metal, all at once, at the same time stirring briskly about, so that the whole gets thoroughly mixed, and the iron is then ready for use. Calcined clay may be used instead of brick-dust. The patentee claims the treating of iron by or with a compound of materials, as above described.

DURABILITY OF COPPER AND ITS ALLOYS.

The following extract from Layard's Discoveries in Ancient Nineveh and Babylon, (Appendix iii., page 670, note 3,) evidently shows that copper and its alloys are durable in connection, when so united as to prevent a galvanic current; but when in mere mechanical connection, such as bolts of iron coming in contact with a ship's sheathing, are destroyed. The specimens collected by Mr. Layard have stood at least three thousand years.

"This was a very remarkable specimen. It was a small casting, in the shape of the fore-leg of a bull. It formed the foot of a stand, consisting of a ring of iron, resting on three feet of bronze. It was deeply corroded in places, and posteriorly fissured at the upper part. A section was made, which disclosed a central piece of iron, over which the bronze had been cast. At the upper part, where it had been broken off, the iron had rusted, and so produced the crack above-mentioned. The casting was sound, and the contact perfect between the iron and surrounding bronze. It was evident, on inspection, that the bronze had been cast round the iron, and that the iron had not been let into the bronze; and in this opinion I am confirmed by Mr. Robinson, of Pimlico, who has had considerable experience in bronze casting.

	Composition.
Copper,	88.37
Tin,	11.33
	99.70

"Some interesting considerations are suggested by this specimen.

"The iron was employed either to economize the bronze, for the purpose of ornament, or because it was required in the construction. If the former, iron must have been much cheaper than bronze, and therefore, probably more abundant than has been generally supposed. No satisfactory conclusion can be arrived at on this point, from the fact, that bronze

antiquities are much more frequently found than those of iron; for the obvious reason, that bronze resists, much better than iron, destruction by oxidation. Although, I think, there are reasons for supposing that iron was more extensively used by the ancients than seems to be generally admitted; yet, in the specimens in question, it appears to me most probable that the iron was used because it was required in the construction. And if this be so, the Assyrians teach a lesson to many of our modern architects and others, who certainly do not always employ metals *in accordance with their special properties.* The instrument under consideration, it will be borne in mind, was one of the feet of a stand, composed of an iron ring resting upon vertical legs of bronze. A stand of this kind must have been designed to support weight, probably a large cauldron; and it is plain that the ring portion should therefore be made of the metal having the greatest *tenacity*, and the legs of metal adapted to sustain *vertical or superincumbent weight.* Now this combination of iron and bronze exactly fulfils the conditions required. I do not say that a ring of bronze might not have been made sufficiently strong to answer the purpose of the ring of iron; but I do say that, in that part of the instrument, iron is more fitly employed than bronze. Moreover, the contrast of the two metals, iron and bronze, may also have been regarded as ornamental."

CHEMICAL EXAMINATION OF IRON SPIKES, COATED WITH COPPER, BY THE PROCESS PATENTED BY E. G. POMEROY.

The following is a report of a chemical examination of the above articles, made by Dr. A. A. Hayes, of Boston:—

This invention presents some peculiar features, when compared with the ordinary modes adopted for coating metals. It is well known that tin plate is manufactured by dipping thin sheets of clean refined iron into hot melted tin, until, by repeated immersions, the surface of the iron becomes more or less thickly coated. The particles of tin adhere to the iron, without any more than the most minute film of alloy of iron and tin being formed. By the process of Mr. Pomeroy, the surfaces of the clean iron spikes have first a coating of copper deposited on them galvanically, and this covering adheres in consequence of a polarized condition of the particles of the iron. If the iron were absolutely pure, a perfectly uniform crystalline covering of copper would exist over every part of the surface. The metal is then protected by a coating or flux, and is immersed in a bath of pure copper, or yellow metal, kept perfectly fluid, until its surface is covered more or less thickly with copper or yellow metal. In this way, reliance is not placed upon a mere coating by adhesion, which could be easily removed; but the unlike metal, iron, is previously covered with copper, and this new surface unites to the metal in a fluid state, precisely as a mass of copper would, if it were immersed in a melted portion of the same metal. This method forms the basis of a new art in working metals, and the value of a single application has been tested, as follows:—

1. A spike, taken without selection from a lot of several thousand pounds, was driven its length into sound white oak timber. A block, including the spike, was exposed alternately to diluted muriatic acid, and air, several days. Every minute opening in the copper was thus found, the iron reached, and a portion dissolved. The resulting salt of iron, and the tannic acid of the wood, gave a bluish black discoloration to the wood. Exposure to the air caused the formation of hydrate of peroxide of iron, which, filling the minute openings, prevented further action. On splitting the block, it was found that the general surface of the spike was unaltered; the iron having been dissolved from those points only where pores or openings had existed, remained as a salt adhering to the spike.

The destruction of iron in sea-water takes place through the absorption of oxygen; the exfoliation of the oxide permits the action to continue, until the strength and size of a bolt become reduced. In the case of these spikes, as the copper remains firm, only minute surfaces of the iron are reached, and where oxide forms, these little orifices which are first made, become closed, and no further action occurs.

In this experiment the acid was a thousand times more powerful than sea-water is, and the effect, in point of time, was greatly increased.

2. Into vessels adapted for the collection of hydrogen, iron bars and copper coated spikes were separately placed. A mixture of muriatic acid and water was added in like quantity to each. The hydrogen which would in this case be evolved, being measured for a given time, denoted the comparative rapidity of solution, for equal surfaces. It was soon found that the iron, of nearly equal surface, evolved so much greater volume of hydrogen, that the quantity of surface could be much reduced; and when it equalled only one-fourth the surface of one spike, and four such spikes were used, the spikes gave one volume, while the iron afforded nineteen. This experiment was varied, and continued six days, and a mean result for rapidity of solution, where the iron was one-sixteenth the volume of the spikes, was as one to nineteen and five-tenths. If the iron surface of the copper-covered spikes at the pores in the copper dissolved with the same rapidity as nail-rod does, the exposed surface of spikes would therefore require 304 times as many days for destruction in this way, as iron ones would.

Under any conditions to which these spikes can be exposed to corrosion, they will have at least the comparative duration of nineteen times that of iron spikes not coated, in sea-water; and as they retain their size unaltered, they will remain firm in their places.

TIN FOILS—CROOKE'S PATENT.

My invention consists in such improvement in the manufacture of tin foils and sheets, that by it I accomplish the reduction of the cost, though retaining those qualities which are essential to the purposes for which such foil or metal is required This I effect by combining the baser and cheaper

metal, lead with tin, not, however, in the form of an alloy or mixture, but so that each metal will be kept perfectly distinct, the tin or superior metal being only exposed, while the lead or inferior metal is encased within. In order to make such sheets or foils, a peculiar ingot or slab must be first made, by which the whole amount of metals to be contained in the intended sheet or foil must be joined at their surfaces, and retained in such position that the subsequent action of the rolls shall not be able to displace or extend one metal more rapidly than the other, for it is evident that the lead, by reason of its being the softer and more yielding metal, would be squeezed out in an undue proportion to the tin, were it not confined on all sides by the tin. I therefore make the ingot or slab for rolling, in the following manner: — First, a metallic mould is made, which shall determine the size of the slab to be cast; the cavity in such mould may be, say six inches wide, one inch thick, and ten inches long; then prepare a slab of lead, as much less in size than the cavity in the mould, as is designed for the different proportions of the metals, say of the following dimensions: five and one-half inches wide, nine and one-half inches long, and half of one inch thick. This, when suspended in the centre of the mould, will leave a clear space all round, and the tin can then be poured in. To accomplish this suspension properly, I prepare small blocks or posts of tin, of a length equal to the space left between the lead and the sides of the mould, and by placing these around on all sides, I sustain the slab of lead exactly in the centre. The surface of the lead being properly clean, or properly fluxed or coated with an alloy of lead and tin, the mould is ready to receive the tin which is poured in, until the whole of the space is filled, the lead being then completely encased within it. The posts of tin of course combine with the fluid tin poured in, and form part of the solid mass. The slab is now ready for the rolls, and may be extended into sheets and foils of any degree of thinness. From this construction of the slab or ingot, it is evident that the lead cannot escape from the tin, but must extend and be pressed out with it, in exactly the same manner, and at the same rate, thus insuring perfect equality in regard to the given proportions first adopted, as to every part of the sheets, no one part having more lead in combination with it than another. Thus, foils or sheets are produced, which, for many of the purposes to which those of pure tin are applied, such as for wrappers of tobacco, caps for bottles, &c., are fully equal in the qualities required to those of pure tin, while they are furnished at a greatly reduced cost.—*Scientific American.*

TEMPERING AND GRINDING STEEL.

Mr. Chesterman, of Sheffield, England, has lately invented and patented several valuable improvements in hardening and tempering steel, and in grinding, glazing, buffing, and brushing steel and other metallic articles. The process of hardening and tempering apply principally to thin steel, such as is used for saw-blades, for example. The hardening is effected in

the following manner: The inventor takes a strip, say from ten to thirty feet long, and winds it into a circular cast-iron case, of about the same depth as the width of the steel. In the side of the case is a grate or aperture, through which a small portion of the outer coil of the steel is made to protude. He then puts a cast metal lid on the top of the case, so as to cover the whole of the steel, and places the case in a furnace, and allows it to get red-hot, when it is removed by one workman, while another seizes hold of the protruding end of the steel, and draws it through a pair of cold steel, metal, or stone dies or plates, by which the steel will be hardened, coming out flat. The dies or plates are to be kept cold, by having cold water applied to them, or they may be made hollow, and a stream of water be caused to flow through them. Shorter and stronger lengths, such as steel saw-blades, &c., are hardened, by placing them in a furnace, and allowing them to get red-hot, and then quickly introducing them and subjecting them to pressure between two dies or plates, mounted in a frame, so as to form a press, by which means they are both hardened and prevented from warping or buckling — care being again taken to keep the dies or plates, whether of metal or stone, cold by the application of water. He tempers these articles in the ordinary manner, and the tapes or strips as follows: After the strip or length of steel has passed through the dies or plates, it is removed to a stretching-table, where one end is made fast between screw-clamps, or otherwise, while the other end is clipped between another pair of screw-clamps attached to a leather strap, which is fastened to a drum or roller turning in bearings, and furnished with a lever or arm, which is weighed so as to produce a gentle strain on the steel. The steel is then oiled or greased, and heat is applied to it from a portable furnace or gas-light, attached to a flexible tube, or from any other source, so as to blaze off the oil or grease, whereby a fine spring temper will be imparted to the article operated on, and it will be left flat and straight. Or a fixed gas-furnace is employed, and the steel drawn from the hardening dies or plates, direct through the gas-furnace, thus becoming hardened and tempered at one continuous operation.

For the purpose of grinding both sides of a flat article, or the entire periphery of a circular or similarly-shaped article, the inventor fixes upon a central tube or axis, a grindstone in the form of a roller or cylinder, and makes this stone plain or indented, with semi-circular or other grooves, according to the shape of the article to be ground; and over this grindstone roller he mounts another similar to it. Upon rotary motion being imparted to the rollers, and the end of the article to be ground being inserted between them, they will draw it through, but without grinding it; the article is then to be drawn or pushed by the workman, in a contrary direction to the rotation of the rollers, and the grinding will then take place in its passage between them. The sides of one of the rollers, when the articles to be ground are flat, are also provided with collars formed of grindstone, and of a larger diameter than that of the rollers, whereby the edges, as well as the sides of the metal article, may be ground, when requisite, at the same operation. Means are provided for adjusting these

rollers to suit the thickness of the articles to be ground, and also for adjusting the stones on the central tube or axis. For the purpose of grinding one side only of a steel or metal article at a time, a plain wooden roller is substituted for one of the grindstone rollers; and combined with this arrangement are guide-rollers, for cross-grinding. — *Scientific American.*

WELDING STEEL ON SHEARS' BLADES.

The welding of steel upon iron is a very particular operation, and one which requires great experience and care to perform. An improvement in machinery for welding steel on the blades of shears, and finishing them, has been made by Robert Dawson, of Huntington, Connecticut. The principal operating parts are two dies, one being of the form required for the back or outer side of the blade, and the other of the face or inner side of the same, when finished. The former die is arranged in a sliding bed, the latter on a roll above it, the former receiving and forming a solid bearing for the whole of the iron part of the blade, and the latter having a flat face to rotate in contact with, and press upon the steel, for welding it to the iron properly, both being caused to move together by gearing between the bed of the lower die, and the roll of the upper die.—*Scientific American.*

MALLEABLE IRON CASTINGS.

Mr. R. A. Brooman, of London, has taken the patent for an invention, which consists of an improved method of preparing wrought iron, so that it may be capable of being poured or cast into moulds, for the production of malleable castings, or articles which shall have all the strength and qualities due to wrought-iron. The invention is designed chiefly for the manufacture of railway wheels; but it is equally applicable to the production of other articles. Scrap or wrought-iron may be employed, or bars or plates cut into small pieces, and it must be melted into crucibles, such as are used for melting blister steel. To a charge suitable in amount to the crucible, one-half of one per cent. of charcoal, by weight, one per cent. of manganese and one of sal ammonia are added. The whole is covered from the atmosphere, and melted in a temperature of about 1,500° Fahrenheit, which temperature is maintained for three hours. The metal is then poured into moulds. Other carbonaceous matter may be substituted for charcoal. The iron thus cast will, it is stated, be malleable, so as to be capable of being treated under the hammer in the forge, and formed into other shapes, and thus also part of the iron may be shaped in moulds, and part completed by forging, so as to produce intricate shapes and ornamental work.

NEW MACHINE FOR ROLLING IRON.

At the British Association, Mr. Clay produced and explained the model of a machine used for rolling taper iron, by which an iron bar may be

rolled of any length, and tapered to any required degree. The principle of the action of the machine consists in keeping one of the rollers fixed on its bearings by hydraulic pressure. A valve, regulated by a fine screw, permits the water to escape, and thus, as the operation proceeds, the rollers become more and more separated, and the iron bar less flattened. By regulating the valve, so as to allow of greater or less escape of the water, the degree of tapering can be very accurately adjusted.

NEW PROCESS OF WHITENING PINS AND NEEDLES MADE OF IRON AND STEEL.

It is well known that pins made of brass wire, are deficient in strength and elasticity, and accordingly they have been replaced by pins made of iron or steel; but it is necessary to tin them over. This operation, however, cannot be performed equally well with iron as with brass; the pins have a rough, uneven surface, which renders them inconvenient to use, as they are liable to tear the cloth.

Messrs. Vantillard and Leblond, wishing to avoid this defect, formed the idea of first covering the iron with a thin coating of copper, or other metal having a greater affinity for tin than iron has; but in order that this result should be satisfactorily attained, it is necessary to polish and pickle the pins before coppering them. The above-named manufacturers have most ingeniously effected the polishing, the pickling, and the coppering, by one single operation. To treat, for example, 2 kilogrammes, (a little more than 4 pounds 6½ ounces,) 4 litres (about 7 pints) of water, 300 grammes (10 ounces 9 drachms, avoirdupois, by weight) of oil of vitriol, 30 grammes (15 ounces, 13 grains, avoirdupois) of salt of tin, 40 grammes (1 ounce 4 drachms 17 grains) of crystalized sulphate of zinc (white copperas), and 7 grammes (about 108 grains avoirdupois) of sulphate of copper, are mixed together; this mixture is allowed to dissolve during twenty-four hours. The bath being thus prepared, it is to be introduced into a barrel of wood, made pitcher-like, and mounted upon an axis. Into this barrel, which has a capacity of about thirty-five pints, the pins are now to be put; it is then turned rapidly during half an hour, when the pins will be found to have received a pickling, a polishing, and a slight coppering. After the lapse of this time, 20 grammes (about 10 drachms 8 grains, avordupois) of sulphate of copper, in crystals, (blue stone,) are to be added, and the barrel again turned during ten minutes, when a solid coppering will be effected, with a finely-polished surface. This done, the liquid in the barrel is to be decanted off, and may be used repeatedly for the same purpose; the pins are washed in cold water, then put in a tray containing a hot solution of soap, and agitated for about two minutes. The soap lye is decanted off, and the pins put into a bag, with some fine sawdust, and shaken, by which means the coppered surface assumes a brilliant appearance. The pins thus prepared may be tinned in the ordinary way. The articles made in this way are far more beautiful and useful than those made in the ordi-

nary way. This process is the more deserving of attention at present, quite independent of the superior quality of the pins, in consequence of the exceedingly high price of brass wire. — *Bulletin de la Societie d'Encouragement.*

ON THE APPLICATION OF THE GASES OF BLAST FURNACES.

Mr. Nowel, in a recent communication to the Socity of Arts, made some statements of interest respecting the practical application of the gases of blast furnaces. It was shown, on the authority of Bunsen and Playfair, and from calculations deduced from data furnished by the posthumous papers of Dulong, that of the heat produced by the combustion of the fuel in a coal-fed blast furnace, only 18.5 per cent. is realized in carrying out the processes of the furnace, the remainder, 81.5 per cent. being lost. This loss, in well-conducted establishments, is no longer permitted. The gases are now collected at the mouth of the furnaces and conveyed, by large pipes, underneath the boilers of the engines and round the hot-air stoves. The principle has been carried out in great perfection at Cwm Celyn: the pipes are six feet in diameter, and are lined with fire-brick; and the gases from two furnaces only more than suffice for the supply of seven boilers, and for the hot blast for both furnaces, at a saving of full ten thousand tons of coal a year.

NEW ENGLISH STANDARD WEIGHTS AND MEASURES.

It will be remembered, that the destruction of the Houses of Parliament by fire, in 1834, proved fatal to the standard yard and pound. A commission was subsequently appointed to consider the steps to be taken for the restoration of these standards, the members of which were all Fellows of the Royal Society.

The late Mr. Baily took a very active part in the preparation of a standard yard; which, however, although constructed most carefully, deteriorated in such a manner as to be unworthy of confidence. Since Mr. Baily's death, the Rev. Mr. Sheepshanks has been engaged on the very difficult and delicate task of constructing a standard yard, while Professor Miller, of Cambridge, undertook to make a standard avoirdupois pound. The liberality of government placed at Mr. Sheepshanks' command apparatus for his purpose far superior to that possessed by his predecessors. His labors were carried on in the lower tiers of cellars in Somerset House, which are very favorable to the work on account of their slow-changing temperature.

After an infinite number of experiments and comparisons, two standards have been constructed. The originals have been inclosed in one of the walls of the new Houses of Parliament;—and perfectly accurate copies have also been placed in the custody of the Royal Society.

The standard yard measure is defined by the interval between two lines

upon a bar of gun-metal. The bar is about thirty-eight inches long, and one inch square; it is supported in a horizontal position upon eight brass rollers, which are carried by levers so arranged that the pressures upon the eight rollers are necessarily equal. The lever frame, with the bar resting upon it, is placed in a box of mahogany wood. The bar is prevented from moving endways by weak brass springs attached inside to the ends of the box, and is prevented from moving upwards by wedges of paper placed under three inverted stirrups. Near to each end of the bar, a cylindrical hole is sunk from the upper surface of the bar to the depth of half an inch, and at the bottom of each cylindrical hole is inserted a gold pin, upon which are cut three fine lines in the direction transversal to the bar, and two fine lines parallel to the axis of the bar. The limiting points of the yard measure are those points of the middle transversal lines which are midway between the longitudinal lines. On the upper surface of the bar the following inscription is engraved :—

Copper.	16 oz.
Tin	2 1-2
Zinc	1

Mr. Baily's metal.

Standard yard at at 62.10, Farenheit, cast in 1845. Troughton & Simms, London.

It is necessary to observe that, although the bar was cast so long ago as 1845, the standard yard has been completed only very lately.

The standard pound weight is made of platinum, representing, when weighed *in vacuo* against the last standard Troy pound, 6,999.9,975 grains, of which the last standard contained 5,760 grains. The form of the weight is a cylinder, with a groove surrounding it a little above the middle of its height for the insertion of the fork which is used in lifting it. On the upper end of the cylinder is engraved the following inscription :—

No. 2.
P. C.† 1844.
1 lb.

The box containing the weight is mahogany,—and when its portions are screwed together the weight is fixed immovably. This mahogany box is placed in a second mahogany box, the lid of which bears the inscription :

Standard Pound, 1853.

ON THE CONSUMPTION OF SMOKE.

The following is an abstract of a paper read before the Society of Civil Engineers, on the consumption and prevention of smoke, by Mr. C. Wye Williams.

The object of this communication was, to endeavor to remove the mystery which had hitherto obscured, what was asserted to be one of the simplest and best understood processes of nature—namely, the combustion of the gaseous products of coal. The nature of flame and smoke was examined, showing that the intense heat caused by the combustion of the hydrogen, was the direct cause by which the temperature of the carbon was raised to that of white heat, which produced the luminosity of flame.

This process was illustrated, by reference to the mode of producing the intense heat and luminosity required for the oxy-hydrogen microscope. In the latter, the piece of lime or carbon on which the heat was projected, was instantly raised to the temperature of extreme luminosity, neither the lime or carbon, however, suffering rapid combustion. In the former, the carbon of the gas was raised by the same means, (the combustion of the hydrogen), to the high temperature, but could not suffer combustion until it was brought into contact, in its turn, with its equivalent of the oxygen of the air. If, however, that supply of air was not provided before the carbon lost its high temperature, it returned to its previous and natural state of a black substance, and gave the black character to the products called smoke.

In effecting the combustion of the gas generated from the coal in a furnace, the first process was merely mechanical, and consisted in bringing the atoms of the gas, and those of the air, into the most intimate state of mixture; such mixture being the *sine qua non* of subsequent chemical union. The mode or means by which this chemical admixture could be effected in the most rapid and intimate manner, involved all that art or human ingenuity could do, towards producing perfect combustion. Reference was then made, to the area recommended by some authorities, as being sufficient to allow the quantity of air to enter a furnace. It had been considered, that even half a square inch of aperture, for each square foot of furnace grate, was sufficient for the combustion of the fuel. This was, however, stated to be insufficient for practical purposes, the proper area for admission being from four to six square inches for each foot of grate, according to the extent of draught and the nature of the coal. This serious difference was supposed to have been caused, by an erroneous calculation of the rate of the current of air entering. For if half a square inch of area was all that was allowed, the air must have a velocity ten times greater than could be shown to have been ever attained. Thus, supposing a furnace to be four feet by two feet six inches, equal to ten square feet of bar surface, this would effect a combustion of 2 cwt. of coal per hour, and require, for the gas alone, a supply of 10,000 cubic feet per hour, or for 20 cwt. of the coal, 100,000 cubic feet. The following comparison of velocities, of the entering air for the supply of the gas, gave some idea of the cause of underrating the required area of admission:—

Air Aperture per square foot of grate.	Velocity of draught per second.	Quantity of air per hour.	Quantity for each ton of coal.
6 sqr. inches.	at 5 ft. per second.	7,500 cubic ft.	75,000
6 " "	at 10 ft. " "	15,000 " "	150,000

Then, if the area were reduced to half a square inch, it would require a velocity of 80 feet per second, to provide for the admission, within the

given time, of the necessary quantity. By close observation, by means of an ærometer, the velocity of the entering current was estimated at from 8 to 10 feet per second, if the draught was good; and from 5 to 8 feet when it was but moderate. Again, it was observed that, by admitting the air through numerous thin films or divisions, the vélocity was necessarily reduced, by mere friction, through so many half-inch orifices, as were exhibited in the models and drawings on the table. In the admission of air to the furnace it was shown, that the great object to be effected was, the division of the air on its admission to the furnace so that no more atoms were brought into contact with the atoms of the gas, at any one moment, than were required for their successive union and combustion. If this were the case, combustion and heat would be generated continuously, as the gas and air came into contact. If, however, the air entered in a body, or even in a film, in larger quantities than could be taken up by the gas before the temperature was lowered, a refrigeratory effect must be the consequence, smoke would be formed and fuel would be wasted. It was asserted, that the phrase "burning smoke" was improper, inasmuch as the smoke did not exist until the gases had left the furnace. Previously to the introduction of the tubular, in place of the flue system, in marine boilers, it had been supposed, that the introduction of the air, on the Argand principle, by a perforated plate, behind the bridge, satisfied all that nature required in producing perfect combustion. The tubular form of boiler, however, rendered a different arrangement absolutely necessary. This was occasioned by the run, or distance between the bridge and the tubes, being so very short, and consequently, the passing along that distance being so limited in time, that the mixing and combustion could not be adequately effected. This, after numerous trials and expedients, led to placing the orifices of admission in the front, or at the door-way end of the furnace. The system adopted by boiler-makers, of contracting the door-ways of marine boilers, much impeded a successful application of the Argand principle. The enlarging the door-way opening, however, afforded sufficient space for the required number of three-fourths or one-half inch orifices. By this arrangement, the length of the furnace, from the door to the bridge, was thus, as it were, added to the length of the run. By this mode of construction, the Argand principle had been applied, with great success to marine boilers. With reference to the supposed necessity for skilful firemen, the paper stated, that the only duty that should be required from the firemen was, the keeping the bars fully and uniformly covered: for if the back end, or the sides of a furnace were left uncovered, the air would pass through them instead of passing through the air-distributors, as that passage offered the hottest and shortest route to the chimney. In fact, it was stated, that unless the bars were well and equally covered, it was impossible to regulate or to control the admission of the air. As to the use of self-acting valves, to regulate the admission of the air, it was stated that after numerous plans had been tried, during the last ten years, all had been discarded in practice, being

found to be worse than useless. The generation of the gas, and the admission of the air through the uncovered portion of the bars, created such irregularity as to defeat all efforts at uniformity, and it was impossible, by any self-acting valves, to obviate the effects of such irregularity.

ON A NEW SMOKE-CONSUMING FIRE-PLACE.

At a recent meeting of the Society of Arts, Dr. Arnott, F. R. S., read a paper "On a New Smoke Consuming and Economical Fire-place, with additions for obtaining the healthful warming and ventilation of houses." The author commenced by stating that the great evils connected with the common coal fires were:—1. Production of smoke; 2. Waste of fuel; and 3. Defect of warming and ventilation. After reviewing the evils arising from smoke in the interior of houses and in the external atmosphere—which in the washing of clothes alone cost the inhabitants 1,500,000*l.* more than the same number of families residing in the country, besides being inimical to health—the question of waste fuel was examined, and the opinion of Count Rumford was quoted, who declared that five-sixths of the whole heat produced in an ordinary English fire went up the chimney with the smoke to waste. This estimate was borne out by the facts observed in countries where fuel was scarce and dear, as in some parts of Continental Europe, where it was burned in close stoves, that prevented the waste, and with these a fourth part of what would be consumed in an open fire sufficed to maintain the desired temperature. The author then proceeded to observe that if fresh coal, instead of being placed on the top of a fire, where it must unavoidably emit visible pitchy vapor or smoke, be introduced beneath the burning red-hot coal, so that its pitch in rising as vapor must pass among the parts of the burning mass, it would be partly resolved into the inflammable coal-gas, and would itself burn and inflame whatever else it touched. Various attempts had been made to feed fires in this way, of which the most important was that introduced by Mr. Cutler about thirty years ago. He placed a box filled with coal immediately under the fire, with its open mouth occupying the place of the removed bottom bars of the grate, and in the box was a movable bottom supporting the coal, and by pressing which the coal was lifted gradually into the grate to be consumed. The apparatus for lifting, however, was complicated and liable to get out of order, which, with other reasons, had caused this stove to be little used. In Dr. Arnott's new fire-place, the charge of coal for the whole day was placed immediately beneath the grate, and was borne upwards as wanted by a piston in the box, raised simply by the poker used as a lever, and as readily as the wick of an argand lamp was raised, and the fire was under command as to its intensity almost as completely as the flame of a lamp. To light the fire, wood was laid on the upper surface of the fresh coal filling the box, and a thickness of three or four inches of cinders or coked coal left from the fire of the preceding day was placed over it. The wood being then

lighted, instantly ignited the cinders above, and at the same time the pitchy vapor from the fresh coal beneath rose through the wood flame and cinders, and became heated sufficiently to inflame itself, and so to augment the blaze. When the cinder was once fairly ignited, all the bitumen rising through it afterwards became gas, and the fire remained quite smokeless for the remainder of the day. In this grate no air was allowed to enter at the bottom, and combustion therefore only went on between the bars. The unsatisfactory results of some other attempts had been owing, in part, to combustion proceeding downwards, owing to the admission of air below.

ON THE CONSUMPTION OF FUEL AND THE PREVENTION OF SMOKE.

At the British Association, Mr. Fairbairn, in a communication on the above subject, explained the principles on which the perfect combustion of fuel depends, and expressed his opinion that by proper attention, and by the adoption of the means already known and practised, the issuing of smoke from steam-boiler furnaces might be effectually prevented. The great secret is to have sufficient capacity in the boiler; and if the boilers had double their usual capacity, the perfect combustion of the fuel, and, consequently, the prevention of smoke, might be readily accomplished. He referred to the steam-engine furnaces of the Cornish mines to prove that when there is a sufficient inducement to the proprietors by the saving of expense, and of incitement to the engineers by competition, the emission of smoke is prevented without any special arrangement to produce that effect. Mr. Fairbairn then described a furnace which he conceived offered great facilities for the more perfect combustion of fuel. It consists of two furnaces united into one, the gases issuing from the coals being mixed together in a single chamber, and then passed in a heated state over the bridge of the furnace, where they are ignited. By this means, and by kepping the fire-bars clean for the admission of air, the combustion was rendered very complete.

An improvement in smoke-consuming stoves has been made by E. A. Hill, of Joliet, Illinois. The fire-box of the stove is divided into two compartments, each having a separate smoke pipe, and both fire-places so connected together that the smoke from one can be thrown over the surface of the other fire alternately by a damper, so that the products of the combustion of both fires pass up the same pipe. For burning bituminous coal, the improvement appears to be an excellent one; for it is designed that one of the fires shall always be full, red and glowing, when the other is supplied with fresh fuel, so that the black smoke (carbonic oxide) which arises when new coals are put on shall be carried over the top of the glowing fire, and mixed with a portion of fresh-heated air, by which means it will ignite—flame up—and be consumed; in other words, form carbonic acid. This stove will not only consume the smoke, but save considerable fuel.—*Scientific American.*

THE BENEFICIAL EFFECTS OF SMOKE.

A writer in the *London Times* argues in favor of the sanitary effects of smoke. He says that smoke, being nothing more than minute flakes of carbon or charcoal, the carbon in such a state is like so many atoms of sponge, ready to absorb any of the life-destroying gases with which it may come in contact. In all the busy haunts of men the surrounding air is, to a certain extent, rendered pernicious by their excretions, from which invisible gaseous matter arises, such as phosphuretted and sulphuretted hydrogen, cyanogen and ammoniacal compounds, well know by their intolerable odor. Now, the blacks of smoke (that is, the carbon) absorb and retain these matters to a wonderful extent. Every hundred weight of smoke probably absorbs twenty hundred weight of the poisonous gases emanating from the sewers and from the various works where animal substances are under manipulation.

SELF-ACTING DRAFT-CLOSER.

A simple and effective apparatus has been devised by Professor Treadwell, of Cambridge, for regulating the draft in ordinary hot-air furnaces. This apparatus acts by the expansion of the furnace itself, so that, whenever the combustion is established and carried to a certain point, the expansion that must attend that state of the combustion moves a catch, and the damper closes with absolute certainty. The contrivance is as simple as an old-fashioned door latch, and no more likely to get out of order.

COOKERY FOR SOLDIERS.

A new method of cooking and heating, the invention of General Dembinski, has recently been introduced into the French armies. The principle of the invention is very simple, but the applications of it are numerous. A cylinder made of zinc, copper, sheet iron, or any other metal, with an inner cylinder containing sand or small stones, is connected by means of two tubes with a very small vessel, which is placed on a fire, or over a gas light or a lamp. The space between the two cylinders, which is small, is filled with cold water. The vessel on the fire, which is made of very thin metal, is filled with water, which boils almost immediately. As the water boils it rushes by one of the pipes to the cylinder, and by the other pipe the water in the cylinder returns to the vessel over the fire, and this process goes on until the whole of the water boils, which is in one-fourth of the time that would be required to bring it to the boiling point if placed in a large vessel over the fire in the usual way. The process is continued until the sand or stones in the inner cylinder have become perfectly heated. Two cocks, close to the cylinder, are then turned, and the pipes being unscrewed, the cylinder is carried by means of

handles to any room which it is intended to warm. The temperature of the room is increased several degrees by the use of this cylinder, which, of course, gives out neither smoke nor smell, and at the end of five hours the heat in the cylinder is still so great that the temperature of the room is very nearly what it was when the cylinder was first introduced. This fact is hardly credible, but the experiment has been made several times with the same result. If more than one cylinder be wanted, the generator remains over the fire, and other cylinders can be attached to it, and successively removed. The economy, convenience, and wholesomeness of this mode of heating may readily be conceived. The cost of an ordinary apparatus complete does not exceed twenty-five francs, and the only part of it subject to wear and tear is the generator, which does not cost one franc. If meat is to be boiled or stewed, a cooling vessel is attached to the cylinder. When the meat is cooked this is withdrawn, and the cylinder can be detached for the purpose of heating a room. This apparatus appears to be admirably calculated for railroad and other carriages, as a small cylinder will for several hours give warmth without an unwholesome emanation of any kind.

ON THE RE-CUTTING OF THE TEETH OF FILES.

The following method of re-cutting, or renewing the teeth of old files, has been patented by Edward Gilbert, of London. The teeth are renewed by a corrosive agent applied to the surface of the file. The files are first cleaned from any superabundance of greasy matter, and then placed in a rack inside a bath composed as follows: With one pound of unslaked lime mix two pounds of potash in one gallon of water, stir the whole intimately together, allow it to remain till three-fourths the liquid have passed off by evaporation, draw off the remaining quarter of a gallon of liquor, and allow it to cool. In this liquor the files are to remain four hours, and are then to be removed and brushed, cleaned in clean water and made quite free from grease, and then immersed in a vertical position in a mixture of one part of sulphuric acid, diluted with two parts of water. The biting action of the acid attacks the whole surface of the files immersed; the continued effect of which is to deepen the several cavities between the cutting points of the teeth, which become as sharp as they were originally. The files must be immersed for from three to six hours or upward, according to the fineness of the files and the strength of the liquid. The files must be withdrawn and brushed from the oxide formed five or six times during the process. The patentee states that the process is at once comparatively inexpensive, and removes so little metal that it may be repeated three or four times on the same file, and thus it will render it advantageous to wear files much less than usual before renewing.

FORDES' ROTARY DREDGER.

This machine consists of a hull of suitable size to carry the machinery. In the middle of the boat athwart-ships, and near the bow, running fore and aft, there is a well-hole, about three feet wide, and twenty-six feet long. In this hole works a wheel, carrying upon its periphery the buckets or scoops, made in the usual manner, with a hinged bottom, secured by a latch. The wheel has ten hubs, and ten sets of arms, stiffened with diagonal braces, to prevent lateral motion; upon each side of the wheel is a segment spur-wheel, into which is geared the pinions driven by the engines.

The journals of the scoop-wheel shaft work in boxes, that can be raised or lowered by a chain and windlass, to suit the depth of the bottom to be operated upon. In a frame at the bow of the boat there are two hinged schutes, one of which, when the machine is in operation, is kept at one inclination; the other, situated above, and leading into the first, to which it is hinged, is raised by each bucket as it passes upwards; as the wheel revolves, the bucket passes beyond the reach of the schute, where the end next the wheel falls beneath the bucket, striking a trigger that opens its bottom, leaving the contents free to fall into the schutes, and be conveyed by them into the transporting scows alongside.

This machine, for some kinds of work, must supersede all others. Where a long stretch can be had, such as a bar of a river, the bottom of a canal, &c., the performance must prove admirable. No time is lost except that spent in replacing the loaded scows with empty ones, and that, by practice, may be reduced to almost nothing. As the material is cut away, the boat is drawn forward by a rope anchored ahead, and passing round a barrel on the wheel shaft; the rate of progress for each kind of cutting being regulated by the proper sized windlass barrel wheel, which can be quickly taken off and replaced by another.

It is said that a machine of the third class, having a wheel 24 feet in diameter, with four buckets, has dug 1200 cubic yards of gravel bottom in a day.—*Jour. Frank. Institute.*

HAMILTON'S IMPROVED DREDGING MACHINE.

This machine consists substantially of a number of scoops, hung in nearly a horizontal position, in a frame which is arranged to be raised or lowered at pleasure, between two firmly-connected boats. As used in lowering shoals and sand-bars, the whole apparatus is to be towed by a steamboat backward and forward, discharging the dirt each time in the deep water which is assumed to be adjacent. The forward end of the frame is armed with joints projecting downward, the effect of which is to harrow up the bottom. Each scoop is so connected to the frame that its forward edge is capable of being raised and lowered to a considerable extent, forming, when raised to a horizontal position, a nearly water-tight

box, to prevent the escape of the contents. A few or the whole of these scoops may be thus brought into action at any given moment, the proper depth of water being indicated by a long rod, loaded with a suitable weight, to dredge on the bottom behind. It is well adapted to operating on a soft bottom, when there is deep water conveniently near, in which the mud may be dumped.

PRATT'S DITCH DIGGER.

At the recent State Agricultural Fair of New York, Mr. R. C. Pratt, of Canandaigua, exhibited a new machine for digging ditches, which appears to combine all the elements of success. By its aid, one man and two horses have frequently dug 150 rods of ditch, three feet deep, in one day, and from 50 to 150 (according to the nature of the soil) is considered a day's work. The machine consists substantially of a scoop and revolving wheel, the scoop scraping, and the wheel carrying up the dirt, until at a sufficient height it is tumbled out upon the sides, at a little distance from the ditch. Several repetitions of the operation are required before the ditch is sunk to a sufficient depth.

The specimen exhibited at the late fair was all of wrought iron, and weighed between 700 and 800 pounds. The diameter of the main wheel was five feet, and the breadth of the diggers or lifters fixed thereon, and that of the scoop or curved channel in which they rise, is about nine inches. Although the lifting apparatus is thus narrow, it is practicable, and, indeed, desirable, to make the small ploughs or cutters which pare the side cuts somewhat wider, so that a ditch of any width, from nine to fifteen inches, may be excavated by the same machine.

The weight of the dirt which is being lifted, the curved channel, and, in fact, of the whole machine, rests on the diggers, which, like the floats of a paddle-wheel, project from the periphery of the main wheel. As the machine is drawn forward by the horses, the diggers are successively forced into the earth, and compel the wheel to rotate, thus carrying up and discharging from the top all the earth caught by the scoop, which is in immediate contact behind. On the extreme rear of the whole are adjusted two cutters or small ploughs, which pare the sides, and tear the earth to a suitable distance below, ready for the next passage of the machine, so that, after the first passage, the diggers are always pressed down into the ground, already loosened to a depth of from two to ten inches, which loosening may be supposed to regulate the depth to which they will be likely to sink. The wheel and its accompaniments being of considerable weight, great muscular exertion would be required of the attendant to prevent its falling on one side, but for a simple and very effectual provision for its support. The stout iron shaft on which the main wheel freely revolves is prolonged some two or three feet on each side, and provided with a light carrying wheel, mounted loose, as in a common carriage axle, to run upon the ground. These wheels are to maintain the upright position

of the machine; but the weight must at all times, when in operation, be allowed to rest on the diggers. In short, the main wheel and the whole machine must be allowed to sink down into a ditch, or rise to the surface, while the carrying wheels simply run lightly on the surface at the sides. This end is accomplished by bending the axle into the form of a large crank at each side, and releasing it from all connection with the machine, except that of passing loosely through the centre. A catch is provided, by which the attendant (who is supposed to be grasping a pair of handles in the rear) may make the connection a fixed one at pleasure; and when desiring to leave the field and travel the road, the weight may, by this means, be thrown entirely upon the carrying wheels.

ON THE EMPLOYMENT OF WATER IN FILLING UP DEEP BORE HOLES IN BLASTING OPERATIONS.

In working the great deposit of magnetic iron ore which occurs under peculiar circumstances in the granite at Moravitza, in the Banat, it has been found necessary, in consequence of the hardness of the rock and ore, to use bore holes, from two to two and a half inches in diameter, and thirty-six to forty inches deep. The packing of such holes with clay being a very tedious operation, Mr. A. Keszt endeavored to substitute water for the clay, with considerable success. One of Bickford's safety fuses, which burns in water perfectly, is attached to the cartridge, and fastened with thread; this cartridge is let down to the bottom of the hole, and about one and a half to two inches of clay firmly packed over it, the remainder of the bore, nearly to the top, being filled with water. In the case of very oblique bores, where the pressure of the water upon the bottom was small, he plugged up the orifice of the bore with a plug of wood, driven with considerable force into it, through a slit in which the fuse passed. More recently still he had used, instead of a small quantity of clay first introduced, to keep the cartridge from becoming wet, a mixture of tar and pitch, which most effectually preserves the powder from damp. Great numbers of trials have convinced him that the blasts fired with this arrangement lose nothing in force, whilst there is a great saving of time, and, consequently, of expense. — *Osterr. Zeitschrift fur Ber-u-Huttenwesen.*

MARTIN'S IMPROVED JACQUARD LOOM.

In Martin's new Jacquard machine, the object had been to substitute for the heavy cards a sheet of prepared paper, punched with given apertures, like the cards of the old machines; but instead of being a series of pieces, two and one half inches wide, laced together, the punched paper formed a continuous band, only three-quarters of an inch wide, thus so diminishing the bulk that the weight of the new band, as compared with that of the old cards, was in the proportion of one to eleven. The method

by which this desirable result had been attained was chiefly by an arrangement, which permitted the four hundred spiral springs on the needles, used in the old machine, to be dispensed with, when, as a consequence, the force and wear and tear due to their resistance would be done away with, and fine and light wires could be made to do the work of strong and heavy ones.

LOOMS FOR WEAVING BAGS.

A very excellent improvement has been made in looms for weaving seamless bags by George Copeland, of Lewiston, Me., who has taken measures to secure the same by patent. This invention does not change the general character of the loom from those commonly employed for weaving plain or twilled fabrics, but consists chiefly in certain modes of constructing, arranging, and operating some of the parts which require to be duplicated. A loom constructed according to this invention requires two sets of harness, either for plain or twilled weaving, according as a plain or twilled bag is required, and all the mechanism necessary to operate the two sets of harness, independently of each other. It also contains two shuttle races, placed one above the other, in front of the same reed, and employs two shuttles, which are both in operation at all times. In weaving a bag, though only one warp is used, two independent sheds are opened, one above the other, and the two shuttles follow one another through the upper and lower sheds, and thus produce a fabric composed of two parts united at the edges, one-half of the warp from which the upper sheds are formed composing one-half or one side of the bag, and the other half from which the lower sheds are formed composing the other half of the bag, the two parts of the fabrics thus formed only requiring to be united at certain intervals, corresponding with the required depth of the bags, to form a continuous web of bags, which, when finished, only require to be cut across at proper intervals to separate them. The bottoms of the bags are formed without any stoppage of the weaving, by the harness, and all the changes are effected by mechanism, which works with the loom, the whole being self-acting. — *Scientific American.*

IMPROVEMENT IN THE CONSTRUCTION OF FLOUR BARRELS.

Mr. Thomas Pearsall, of Tioga county, N. Y., has taken a patent for a barrel especially adapted, as he thinks, to secure flour or meal from souring. His theory is, that the contents of the ordinary barrel commence to heat in the centre of the mass, and that such heating might be prevented by inserting a hollow tube in the centre of the barrel. His barrels are made like those in ordinary use, (except that they must be larger, to allow of the same contents,) and the heads are bored with a three or four-inch auger. The barrel is then taken with one head out; a hollow tube fitting the hole in the head, and open at both ends, is inserted in the remaining

head, and stands upright in the barrel, around which the flour or meal is placed. The other head is then put on, the tube protruding three-quarters of an inch, and the latter is then clinched or battered down on the outside, leaving a hole the diameter of the tube, entirely through the centre of the barrel. If the theory noted above is correct, and if the tube, which is made of sheet iron, will allow the same evaporation and escape of heat at the sides of the barrel, then Mr. Pearsall's invention may prove a valuable one.

A NEW MODE OF MANUFACTURING PAINT BRUSHES.

A very simple and effectual mode of manufacturing paint brushes, without involving the necessity of driving the handle through the centre of the brush, has been invented by Adonijah Randel, of Williamsburgh, N. Y. The nature of his invention consists in placing the hair of which the brush is to be made in a metal ring, and securing it therein by cementing or sizing the roots, so as to prevent the escape of the hair, and then uniting the back end of the ring, by riveting or otherwise, with a back plate, which receives the handle. The hair is most effectually secured in this manner, and it forms a solid brush; it is easily constructed, durable, and more convenient than those in use.

WIRE GAUZE FOR BANDAGES AND SPLINTS.

Specimens of this article have been exhibited before the London Medical Society, by Mr. Startin, the inventor. The material employed is flattened copper or iron wire, and costs about 1*s*. 4*d*. per square foot; and if the expense were not an object, the materials might be plated. The usual mode of application is, first to obtain a pattern for the splint by means of cartridge-paper, and then carefully to cut the sheet of gauze to the pattern. The splint further requires that the edges should be cut transversely at intervals, and the free edges covered with thin lead or adhesive plaster. Folds of linen, wet with water, are placed upon the limb underneath the splint, and the whole apparatus is kept in position by rollers or tapes. The merits of the invention were said to be those of lightness, cheapness, coolness, and affording the opportunity of readily applying lotions without disturbing the bandages. It was recommended in fractures, resections of the joints, and, indeed, in almost all instances in which cradles and splints are ordinarily employed.

VICE'S SELF-REGULATING WIND-MILL.

Mr. T. C. Vice, of Rochester, N. Y., has recently invented a self-reefing wind-mill, designed to operate on a large scale. The arms and frames are as usually constructed, but the canvas sails are filled with hanks or rings at each end running loosely on an iron rod, also with rods

and loops at suitable distances along its length, so that the sail is prevented from slatting, while at the same time it is at perfect liberty to be extended or contracted by suitable cords. The main shaft of the mill is hollow, and through it leads a light shaft, which carries on its end, and in front of the centre of the wind-mill, a bevel wheel. This wheel gears into power wheels keyed on the end of light shafts which extend the whole length of each arm, having bearings at proper intervals along its length. Revolving these shafts in one direction, contracts the sail by shortening a set of cords leading directly to the leech or edge of the sails, while revolving them in the other direction releases these cords and contracts another set, which are rove through sheaves or through staples on the opposite side, and serve to extend the sail. When all is right, the small shaft in the centre of the main driving shaft is allowed to turn with it; but if the wind freshens and the mill moves too fast, the small shaft must be retarded, which will have the effect, by revolving the bevel wheels, to reef or contract the sails. As the weather moderates, and more sail becomes desirable, the surface may be extended by giving the regulating or central shaft a greater velocity.

This arrangement is easily adapted to employment with a governor, so as to be literally self-adjusting, and in any event will, if successful in practice, save much of the most disagreeable labor in attending wind-mills —that of reefing in cold and wet weather. A forty horse-power mill, or one the sails of which are each thirty-three feet long and six feet wide, would probably require considerable power to extend the sails thus simultaneously; but it may be recollected that this operation will usually be performed when the wind is light, the action in reefing being merely that of a brake to retard the wheel, and the action of the cords on the sails is, in this case, direct. Mr. Vice has provided means for making the mill itself supply the power for this purpose, and considers the whole susceptible of complete control by an ordinary governor.

An improvement in wind-mills has also been made by Daniel Halladay, of Ellington, Connecticut. This consists of the attachment of wings or sails to rotary movable spindles furnished with levers. These levers are also attached to a head which rotates with the sails upon the same shaft. Another lever is attached to the head. This is connected to a governor, which slides the head upon the shaft, so as to cause the levers to turn the wings or sails. The necessary resisting surface being thus presented to the wind, a uniformity of velocity is attained. The proper regulation of the obliquity of the sails, so as to adapt them to the varying motive force of the atmosphere, is represented by the inventor to be thus secured, without difficulty, to a degree which renders his mill more constantly available than those hitherto employed. The mill built by him has five feet wings; that is, the diameter of the wind wheel is ten feet; and it has been in operation for six months, without a hand being touched to it to regulate the sails. It is so contrived that nothing but a squall of great severity falling upon it without a moment's warning can produce damage.

The mill mentioned has drawn water from a well twenty-eight feet deep, one hundred feet distant, and forced it into a small reservoir in the upper part of the barn, sufficient for all farm purposes, garden irrigation, and "lots to spare." The cost of such a mill will be $50, and the pumps and pipes about $25. It is elevated on a single oak post a foot square, the turn circle being supported by iron braces. The wings are made of one longitudinal iron bar, through which run small rods: upon these rods, narrow boards half an inch thick are fitted, holes being bored through from edge to edge, and screwed together by nuts on the ends of the rods. This makes strong light sails, but, as will be seen, are fixtures not to be furled or clewed up; but they are thrown up edge to the wind by a very ingenious and simple arrangement of the machinery, which obviates the great objection to wind-mills for farm use—the necessity of constant supervision of the sails to suit the strength of the wind.

Wind is undoubtedly the cheapest power that a farmer can use; and, notwithstanding its inconstancy, if this improvement operates as well as it bids fair to in the single mill erected, it will be applied to many valuable uses.

WELLMAN'S SELF-STRIPPING TOP CARDS.

An improvement of no inconsiderable importance, considered by many second to none which has appeared since Arkwright's invention of the rotary cylinder, has been lately introduced in the carding department of the cotton manufacture by Mr. George Wellman, of Lowell. Mr. Wellman appears to have accomplished what several others have repeatedly attempted; he has attached to the top cards of an ordinary carding machine an automatic stripper, which carefully lifts each card from its place, strips it by a movement closely resembling that of the hand stripper, but much more gentle, equable and effective, and returns it to its place, accomplishing the work with any necessary degree of rapidity, and at a considerably less expense for cards than in the present destructive method. Mr. Wellman's invention dispenses with a great part, if not the whole, of the gang of strippers heretofore indispensable, and the expense of stripping is reduced to that of a much less frequent stripping even of the cylinder. It has been adjudged desirable to make the carding machine larger than usual in cases where this invention is to be applied, not from any necessity, but as a matter of economy, the attachment, which by the way may be applied to any cards now in use, costing no more for a large than for a small card, and the presence of large cards adding considerably to the amount of work done on a given area of floor. Mr. Wellman's machine has been set in practical operation but in one case,—a single machine in the works of the Merrimack Company, Lowell,—where it has succeeded so completely during a trial of a little more than eleven months as to secure the favor of cotton manufacturers from all portions of the country. The Merrimack Company have now in course of construction three more machines from

the same pattern, the expense of repairs being found to be, in consequence of the slow motions and the equal distribution of the wear, much less than was anticipated. The number and variety of the motions in this device are said to exceed even that of the famous card-sticking machine, the operations of which have been several times exhibited in the mechanical department of the various fairs in our principal cities. This complexity of the mechanism has been endured rather than to involve the immediate *working* parts in any motions except those absolutely necessary. Several devices have been patented by other parties at various times for stripping top-cards by automatic apparatus, but they have failed chiefly in this point, viz. : that the motions to which the cards were subjected were found to render almost utterly impracticable the delicate adjustment which is necessary in this species of mechanism.

Wellman's machine lifts, strips, and replaces the cards with a motion very closely resembling that of the hand; and having originated with a thorough practical carder, who has given this machine his enthusiastic attention for several years, it may safely be judged worthy of the immediate attention of all interested in the rapidity and cheapness of the cotton manufacture.

NEW MORTISING MACHINE.

A very light and efficient machine, equally well adapted to mortising, ganing, or tenoning, in either soft or hard wood, has been recently patented by Messrs. Plumb, of Honesdale, Pa. The inventors appear to have stepped boldly out from the beaten track, and to have produced a device novel in several important respects, and worthy of admiration, on account not less of its obvious convenience than of its smooth, accurate and rapid performance. The machine, when driven by hand-power, is readily moved to any desired point on the timber—a quality which of itself sufficiently commends it to the favor of practical workers in heavy lumber. Unlike the ordinary varieties of mortising machines, this is capable of cutting very close to the edge or end of a stick, the great distinguishing feature of the invention consisting of the employment of a species of miniature plane-iron, to shave rather than chip down the material. Two chisels of proper width play vertically at proper distances apart to mark the ends, while a stout arm projects downward and travels to and fro between them. This arm, which receives by very simple mechanism a motion precisely adapted to its purpose, dovetails into a small steel cutter, or double-lip chisel, which planes in either direction with each movement of the slide. The machine proves itself adapted to every kind of heavy work, being capable of sinking mortises from two to ten inches long to a depth of eight inches, and of any breadth from three-eighths of an inch to three inches, according to the chisels and cutter employed. Ganes or rectangular cavities on the corners of stuff are executed with equal facility, the fixing of the machine in any required position being readily effected by the aid of a simple clamp.

HUTCHINSON'S IMPROVED STAVE-JOINTER.

Mr. C. B. Hutchinson, of Aubúrn, N. Y., who has heretofore devised several important improvements in machines for the manufacture of staves, has recently invented a machine which joints the staves entirely by sawing; and the means by which the proper swell is given to the bilge, and the proper bevel to the edges of staves, of any width, make it an object of considerable curiosity. A narrow stave may be succeeded by a wide one, and this again by one extremely narrow, a single and easy motion of a lever (supposed to be always held in the left hand of the attendant) being sufficient to adapt the parts in every respect. The saws, two in number, are circular, and mounted side by side, although on separate shafts or arbors. Each arbor is carried in bearings on a movable carriage, so that the saws may be made to approach or recede from each other. The motion of the carriage is controlled by grooves bent vertically in such a manner that the saws would fit face to face if brought quite together, but become inclined as they separate, the upper points being always nearer than the lower. These two carriages are connected by links to the aforesaid lever, so that they approach or recede simultaneously, from which it follows, that, whatever their distance apart, the bevel in which they cut is always closely approximating to that desired. The method by which the bilge or swell in the middle of the stave is produced is perhaps still more admirable, it being perfectly self-adjusting. The lever, and consequently the position of the saws, being held stationary during the jointing of a stave of any given width, if the wood was fed up in a rectilinear line it would be sawn in the proper bevel, but of equal width throughout. The means by which the proper swell in the middle is attained in this machine are simply that of allowing the stave to be moved forward in a curved rather than a straight line. The feed apparatus is in fact a species of endless chain, the links being equal to that of the longest stave ever required, and the wood being held between hooks on the links, which tighten by their own motion. The joints or hinges of the chain being carried in guides, nearly horizontal, but curved so as to be highest in the middle position, or between the saws, the stave is in fact a chord of an arc, and the middle passes the saws at a lower point, and where the saws are wider apart, than do the ends. By properly proportioning the curve given to the guides, any amount of swell may be given as required. A set of Hutchinson's machines, as now perfected for cutting, jointing and crozing, are stated by the proprietor to make from 800 to 1,000 barrels per day.

MELLEN'S CIRCULAR PLANER.

It frequently occurs in the operations of the machine shop that portions of cranks, arms, straps, cams, &c., requiring to be elegantly finished in a curvilinear form, are so connected to other plane surfaces or projecting portions as to preclude the possibility of their execution by any of the

tools ordinarily employed. A circular planer, designed to supply the want thus daily rendered apparent, has been patented by Mr. D. F. Mellen, of Wentworth, N. H., planing to any radius between one inch and twenty feet by means which, avoiding technicalities as far as possible, may be explained as follows: A rack is secured on the inner side of one of the posts, and into this mesh the teeth of a gear-wheel, which latter is mounted on a vertical axis on the carriage or "plate" of the planer. On the same vertical axis is fixed a second gear-wheel, which may be of either greater or less diameter than the first, and into this second wheel mesh the teeth of a second rack. The latter is attached by an eye at the extremity to a pin on the under side of a circular plate which lies in a horizontal position a few inches above the face of the ordinary carriage. On this circular plate, which is free to rotate or oscillate in a horizontal plane, the article to be planed is secured in the usual manner, while the gear-wheels, by locking on one side into a fixed rack, and on the other into a rack which may be connected to the circular or face plate at any point desired, compel the work to rotate or oscillate with every motion of the carriage. The adjustment of the machine to planing in any curve required is further facilitated by providing a set of wheels having a variety of ratios each to the other, any of which may be mounted on the vertical axis at pleasure.

WOOD-SCREW ROTARY MACHINE.

Messrs. Wilson and Wiley, of Providence, Rhode Island, are the joint inventors of a machine for making wood-screws, which equals in rapidity of execution four of the best machines now employed in that branch of manufacture. The machine is termed the Wood-Screw Rotary Machine, all the principal movements being of a continuous rotary character. Wood-screws, termed screw-nails by some English authors, are usually completed in three machines, one only of which is termed a "wood-screw machine." The first takes wire from the coil and transforms it into "screw-blank" by motions closely analogous, if not identical, with those of the common rivet-machine. Another machine saws a shallow score across the top of the head, while the main machine, on which all the study and inventive skill are necessarily bestowed, seizes the blank and cuts the proper thread thereon. The thread of a wood-screw is all produced by removing the metal between, there being none of the metal squeezed up as is done by the ordinary dies of the machine shop, so as to make a screw of greater total diameter than the original wire. The blanks being fed in by self-acting mechanism, are successively caught by a pair of jaws in a revolving chuck, held firmly by the head, and compelled to rotate steadily in one direction, while a properly-shaped tool is repeatedly pressed against its side and moved towards the point. Several reciprocating movements are thus necessary, even with a sharp and keenly-adjusted tool, before the thread is sunk to the required depth. Such, although usually concealed with some care from the gaze of the uninitiated, is believed to be the method

by which these useful instruments are generally prepared, and it is certainly that employed in the new machine, excepting with regard to the cutting tool and its movements. The new machine, like the older varieties, completes the deep spiral crease only by a repetition of shallow cuts, each scraping deeper than its predecessor—one main point of difference lying in the fact that the new machine carries the tool, or rather a series of tools, on a slowly-revolving horizontal wheel—the movement being continuously rotative. This arrangement not only saves the time otherwise lost in the return motion, but avoids the employment of much complex mechanism. A point of equal or perhaps greater importance is gained in dividing the destructive effect on the edges of the cutters between eight tools, (that number being employed in each series,) so that, other things being equal, this machine, once adjusted, would remain sharp eight times as long the other. The simplicity and compactness of the rotary, however, allow four machines, so to speak, to be combined in one with decided advantage, so that one of the ponderous constructions, which are some four feet square and three feet high, throws out the finished article with four times the rapidity, and remains in order, from the principles of its construction, something like eight times as long as the older devices.

THE SILK MANUFACTURE IN ENGLAND.

All the silk heretofore manufactured in England, either into cloth or spun yarn, has been from raw silk imported in the hank state, that is, wound off the cocoons into hanks by the natives of those countries from which the silk was imported. It was supposed that the winding off from the cocoons could never be performed by machinery; and as hand labor was so much cheaper in China, India, and Italy than in England, it was held by the English manufacturers that the cheapest way for them to obtain it was in the state of raw silk yarn. We learn by the *London Artisan*, that in all likelihood the English manufacturers will hereafter import all their silk in cocoons, and wind it off themselves, at a great saving. This has been effected by the invention of a new machine invented by John Chadwick, a silk manufacturer in Manchester, and T. Dickens, a silk dyer. The machine consists of an iron framework, about four feet wide, four feet high, and four yards long. On each side there is a row of thirty bobbins, arranged vertically, about eighteen inches from the floor. They are furnished with the ordinary fliers for encircling them with the thread as it is produced; and to each of the sixty bobbins there is a motion, by which each can be thrown out of gear independently of the others. Over the bobbins there are on either side thirty copper troughs or basins, containing water at a temperature of about 120 degrees. In each of these troughs float six Syrian cocoons, and the silk reeled from these 360 cocoons by means the least complex in their nature. The continuous fibre does not lie in circles upon the cocoon, but describes a form very similar to the figure 8, placed on the surface in a longitudinal direction,

thus, ∞. As the filament is drawn off, the cocoons have a slight oscillating motion in the water; and to keep them from entangling one another, the basins are provided with brass wires, of proper shape, a little above the surface of the water. Nearly a foot above each basin there projects a wire, about three inches long, covered with some soft woollen or other substance; and over this material each set of six filaments is drawn, the effect being to cleanse them from superfluous moisture, and from any impurities which may adhere to the slender thread. To perform this object, the throwster (in a second stage) resorts to a special winding, the thread being drawn through a groove: since, however, it is then in a dry state, the slight impurities are not likely to be so easily removed from the fragile fibre as when it is moist. After descending from the cleansing part, the six filaments pass through a small curve made of glass, and are received by the flier, and spun upon the revolving bobbins. By this treatment the winding into hanks, as performed by the silk growers abroad, the winding on bobbins from the hank, and also the cleaning process, as heretofore performed in England by the throwster, are entirely dispensed with; a perfect thread of silk, twisted or spun, being furnished at one operation; so that, if the silk be intended for organzine or warp, it only requires the further process of doubling and throwing; but if for tram silk, one process is sufficient, as thread can be easily varied in thickness by simply increasing or decreasing the number of cocoons placed in the basin.

One young girl can easily superintend thirty troughs, and a continuous thread can be produced to fill a bobbin, free from knots or piercings; for, as any single filament breaks, the new end has simply to be placed in contact with the other five, and becomes one with the thread; and, as the cocoons end at different places, the whole is produced in the same number of fibres. A bobbin of China silk was inspected of double the fineness of any China silk imported, equal to the finest French thrown silk, and calculated to be worth more by 8*s* or 10*s* per pound than the same kind of silk would have been if reeled from the cocoons in China—a prior process of preparing cocoons for the reeling is carried on in the same room. They are placed for a few minutes in a solution of soap and hot water. By means of a perforated ladle they are then removed to an adjoining trough of warm water; and here, with surprising facility, the principal end of the silk on each cocoon is found by the hand of the girl who discharges that duty. The water detaches the end, and she catches it from the floating surface, sometimes taking up half a dozen such ends of silk at a time. A little is drawn off, and then these cocoons are placed in a basin, the ends hanging over the side. The two girls who superintend the reeling fetch them as they may be required, and place them in a trough at the end of the reeling frame, from which they remove them to the respective basins, to substitute the cocoons as they become exhausted of silk. The apparatus strips the silk very perfectly—in fact down to the thin covering which encloses the chrysalis. It is stated that four pounds'

weight of cocoons abroad or in France (where reeling has been performed for a few years with an instrument nearly the size of this for two sets of cocoons) will produce one pound of silk, but that by this process more than one pound weight is obtained. A new channel in the business will require to be opened—that of importing the cocoons. These have never been supplied, because they have never been demanded; but we suppose they would follow the usual law in this respect which rules other merchandise, and find their way to a good market.

The patent is drawn so as to secure to the patentees the entire ground of reeling or winding (either with spin or without) direct from the cocoons, on bobbins or any other surface, so as to dispense with the loose skein of raw silk; and it is not improbable, now the ground is broken, that other machines, with the license of these patentees, may be applied to the same object.

The silk made by this machine is stated by the *Artisan* to be twice the fineness of the China silk which is usually imported, and worth two dollars more per pound, and a greater quantity of good silk is obtained from the cocoons—there being less refuse—than by the hand process, or by another apparatus which has been in use for two years in France.—*Scientific American.*

GILDING SILK, COTTON, OR WOOLLEN THREAD.

The following is an abstract of a patent granted to Albert Hock, of Paris, for gilding silk, cotton, or woollen thread. Some things not mentioned in the patent are here given, in order to impart a complete understanding of the whole process.

Description.—Take a roller of wood, of about 3½ inches in diameter, or of such thickness that the metal leaf intended to be used will pass around it, to avoid waste of leaf. The length of this roller must depend on the quantity of silk or other thread to be wound thereon. The silk or thread, before it is placed on this roller for gilding, must be run upon one long reel, and run through a box containing some gilder's size, made of parchment cuttings, or a weak solution of gum, on to another reel, passing through a slit in a piece of cloth, after leaving the box, to wipe off the superfluous size. The thread must be run upon the second reel in such a manner that one thread shall not lie on the top of another, but be laid along spirally, from end to end. It is there suffered to dry, and is then fit to be run on the roller, on which the metal leaf is laid. It is run upon this roller also, spirally, with a space between each thread of its thickness, to allow the leaf to be pressed down and between each. When the thread is run on the metal-leaf roller, the whole is subjected, for a few seconds, to the vapor of soap-suds; then metal leaf is laid upon the thread, and pressed firmly down with a pad of dry cotton, when the metal leaf is found to adhere to the thread, which may then be run off on a spool, passing to the same, between glass or bright metal surfaces, to burnish it.

In some cases, the metal leaf is only applied to parts of the silk or other thread, leaving the other parts uncoated; or different metals, gold and silver leaf, may be applied in sections, or different colored leaf of the same metal may be applied, by which means varied and beautiful fabrics may be produced, especially in using such thread for weft, and weaving it into cloth fabrics.

Care must be exercised to have the thread perfectly coated with size or gum before it is run on the roller of metal leaf, and it will answer perfectly if the gummed thread itself is only slightly damped, to make the leaf adhere.—*Scientific American.*

MANUFACTURE OF WOODEN WARE.

The general tendency of Yankee ingenuity is towards labor-saving machinery. As a race, the Yankees cannot, perhaps, be considered lazy; they, nevertheless, evince a wonderful propensity for dodging hard work in every possible way. Steam power, wind power and water power are put to the most menial services, as well as to those of the greatest magnitude; and machines are contrived for almost every occasion of life, from the weaving of cloths and carpeting to the churning of butter by dogs or sheep. Hand labor is becoming daily less and less direct in its application to manufactures, and might in time become, perhaps, entirely obsolete, were it not that the increase in the means of acquiring comforts and luxuries begets a corresponding increase in the demand for them. New wants are being constantly developed; and what was but yesterday a luxury, to be enjoyed only by the few, becomes to-day an imperative necessity for the million.

Thirty years ago, tubs, pails, and other articles of wooden ware, which hold so conspicuous and important a place among the household utensils of every family, were made entirely by hand. The thrifty Yankee farmer, having garnered his crops in the fall, and made ample preparation for the long New England winter, would, when driven in doors by the drifting snows, retire to his little cooper-shop, set off from the wood-shed, or attached to the barn, and improve the season of rest from agricultural labors by turning out a few dozen of pails, or "nests" of tubs, which he would exchange at the country store for West India goods, or calicoes, or peddle around among the inhabitants of the neighboring villages. This mode of manufacturing was called, in common parlance, "set work." Wooden-seated chairs, settees, broom and mop handles, clothes pins, trays, card boards, boxes, &c., were also manufactured in the same manner, to a large extent.

The commencement of the manufacture of wooden ware to any considerable extent, as a regular branch of business, dates about the year 1825. A "patent pail" manufactory was about that time established in Keene, N. H., and others in Troy and Brandon, Vt., were started soon after. The next year, several manufactories were commenced in Massachusetts and

New Hampshire, and the business began to assume some degree of consequence. In the year 1831, the first "patent tubs" were manufactured in Fitzwilliam, N. H. At this time there were not more than $20,000 worth of wooden ware annually manufactured in all New England; but soon after extensive manufactories were established in Winchendon, Gardner, and Hingham in this State, and in various parts of New Hampshire, &c. In 1845, the manufacture of strictly wooden ware in Massachusetts was estimated at nearly half a million, and probably exceeded that amount; at the present time, the manufacture extends more or less to every State in New England, and amounts to three or four millions of dollars annually, most of which finds its way to this market.

A large amount of the wooden ware manufacture of Maine and New Hampshire is carried on on Boston account, but there is also a considerable portion of the articles manufactured in Worcester County which finds its chief market in Rhode Island. The bulk of the articles manufactured, in proportion to their value, operates as a hinderance to their seeking distant markets; yet the amount of this description of goods annually shipped to distant ports is quite large, and is rapidly increasing.

The following statement, furnished us by a friend who is thoroughly conversant with this important branch of trade, will give an idea of the rapidity with which the business has hitherto increased, and furnish some data for estimating its future growth:—

Number of Dealers in Boston in 1831, - - - - -	2
Capital invested, - - - - - - - - -	$10,000
Probable amount of business, - - - - - -	40,000
Number of Dealers in Boston in 1844. - - - - -	10
Capital invested, - - - - - - - - -	250,000
Probable amount of business, - - - - - -	1,500,000

The manufacture of corn brooms constitutes a part of this business, which is by no means to be overlooked, amounting, annually, to about a million of dollars, and half the trade concentrating in Boston. We have heard the opinion expressed, that the number of brooms used in any community furnishes the surest criterion from which to judge of its moral advancement; and considering the important part which this insignificant little instrument sustains in regard to domestic comfort and neatness, the opinion may be correct. According to this standard, the American nation must be in the most exalted stages of moral development and progress; but in communities where feminine difficulties are customarily settled by testing the strength of broomsticks, we imagine the rule will hardly hold good.

As is the case in all other branches of manufacture, the wooden ware of New England excels in cheapness and excellence. In some of the Southern and Western States, attempts have been made to introduce the manufacture by machinery; but, hitherto, the Eastern manufacturers have been able to compete successfully with them in their own markets, both in regard to the cheapness and excellence of workmanship of their wares.—*Boston Atlas.*

NEW METHOD OF EXTRACTING COLORING MATTERS.

At a recent meeting of the Society of Civil Engineers, M. Loysel exhibited a simple and ingenious apparatus for extracting coloring matters from dye-woods, and also for obtaining infusions or extracts of vegetable substances for medicinal or other purposes. The principle of action was that of direct hydrostatic pressure, applied by a simple and inexpensive apparatus. The substance to be operated upon was placed within a cylinder whose bottom was finely perforated ; a similar pierced diaphragm was placed over it, so as not to produce any pressure ; the liquid, either cold or hot, was poured into an upper reservoir, whence it descended by a centre tube to beneath the lower diaphragm, and was forced upwards by the pressure through the superposed substance, every particle of which is saturated in its passage, expelling the air, and carrying before it all the finest portions to the upper strata, against the under side of the upper diaphragm. When a sufficient quantity of liquid had been passed, or the infusion was completed, a cock was opened, which permitted the infusion to return from above, by its own specific gravity, through the substance already operated upon, thus completing the abstraction of any coloring or other matter not previously taken up, and at the same time filtering the liquid. By a second and similar process, any thing still remaining in the substance could be extracted. It was practicable, by varying the height of the column, to give any degree of pressure ; and by the application of a lamp, or, in a large apparatus, of a coke fire, the temperature of the decoction could be maintained as might be desirable. By another modification, the steam generated in a small boiler regulated the action of the apparatus. The system was described as being adapted to very numerous purposes, and the familiar application of it to making coffee was exhibited ; the apparatus consisted of one vase, either of glass, china, or metal, whose cover, on being reversed, formed the reservoir and pressure column, and in a very few minutes clear strong coffee was produced.

CARYL'S FLAX-CLEANING MACHINE.

In this machine, the flax straw is fed upon an endless apron, and passed between several pairs of fluted rollers, to break the wood, thence through a pair of feed rollers, armed with coarse cards, the teeth being hooked towards the fluted rollers, to prevent the flax from being thrown too rapidly into the machine by the picker.

The picker is a cylinder four feet in diameter, having on its periphery from sixteen to thirty-two bars, three feet long. On each of these bars is a row of teeth, and between each of the bars are rods at a distance of three-quarters of an inch apart, which rods hold the flax up to the cards above, but at the same time permitting the dirt to fall through them. Above this picker are cards three inches wide and three feet long, through which the

flax is drawn by the picker. The flax is carried upward and over to a point opposite the feed roller, where it is met by a brush cylinder revolving downward towards the picker, and with twice the speed of the picker. Below the point of contact between the teeth and the brush is a tin spring, which presses slightly against the face of the brush; the brush, revolving downward, reverses the position of the ends of the fibres, thus pulling off the flax from the teeth and passing it between itself and the tin, pressing it half round itself, where it is met by a blast of wind from a fan blowing in an opposite direction to the rotation of the brush, and by which it is stripped from its surface in a state ready for the market, and suited for immediate use in the carding mill.

This machine, it is stated, can break about 3,000 pounds of straw per day, delivering its product in a finished shape, and requiring the attendance of two men and three horse power.

IMPROVEMENT IN THE PREPARATION OF HEMP.

The hemp, after being stripped, is put into a vat or tub, with a sufficient quantity of water to cover it. The water is kept at a temperature of about 50 or 60 degrees for fifteen hours, when it is drawn off and replaced by other water, containing two pounds of soda and two pounds of soft soap dissolved in it for every 100 pounds of hemp. The heat of this liquor may be 100 degrees, or it may be boiled in it for five hours. The hemp is then taken out and dried in the open air, or in a stove room, at a low temperature. When it is dry it is passed between fine fluted rolls, whereby it acquires the softness of flax without losing its original strength. This treatment of hemp, it is said, enables it to be spun like flax.

MACHINE FOR SOFTENING FLAX.

Robert Boyack, of Poughkeepsie, N. Y., has invented an improved machine for softening flax. The improvements consist in having a vertical reciprocating plate with a slot through it, which works between two pairs of fluted rollers. The flax to be operated upon and softened passes from a feed trough, between one pair of the fluted rollers, and through the slot in the reciprocating plate, and from thence through the other pair of fluted rollers. The reciprocating plate subjects the flax to a rubbing frictional action, which renders it soft and pliable, without injury to its fibre.—*Scientific American.*

CLOCKS FOR CHINA AND JAPAN.

The latest piece of Yankee clock ingenuity is a clock for the Japan and Chinese markets, that measures time as the hours are counted in China and Japan, the hands making a diurnal revolution within twelve Chinese hours. The characters upon the dial plate are Chinese. The inside circle

has four characters, showing sunrise, meridian, sunset and midnight. The next circle exhibits the odd and even hours; the even hours are designated by a bold figure, and the odd hours by smaller ones. The dial there has the common minute marks, and on the extreme outside was the Chinese numerals, running from one to twelve.

FRAME FOR GRAPE VINES.

Mr. S. O. Cross, of Sandy Hill, N. Y., has invented a very convenient frame or trellis for grape vines. The advantage of the frame is, that it is on hinges at the bottom, so that it can be raised and lowered, pitched at any angle, and either laid upon the ground or made perpendicular. By this means the posture of the vine can be changed according to the weather and the season, without in any way injuring its vigor and fruitfulness.

MATERIALS IN THE GREAT WALL OF CHINA.

In a lecture on China, Dr. Bowring said it had been calculated that if all the bricks, stones and masonry of Great Britain were gathered together, they would not furnish materials enough for a work such as the Wall of China; and that all the buildings in London put together would not have made the towers and turrets which adorn it.—*Builder.*

IMPROVEMENTS IN SAFETY LAMPS.

After the invention of the wire-gauze safety lamp of Davy, certain imperfections began gradually to reveal themselves. In the first place, it was found to give so little light that the pit-men seized every opportunity of removing the gauze, finding, in point of fact, that their work could not be done with the imperfect light. And, in the second place, the great fact began to be developed, that this lamp, however secure in a still atmosphere, was not safe in a current. An account of the various attempts made to remedy the defects of the Davy—viz., insecurity in a current and deficiency of light—would fill a volume. Until within a recent period, however, two lamps only had been devised, which were able to supersede the Davy, viz., of Clanny and Museler. Dr. Clanny found that if the lower part of a lamp were made of thick glass, and the wire-gauze cylinder retained above this, two things arose—1st. The current of air descended to feed the flame in converging curves, and the gaseous products of combustion ascended in diverging curves. And, 2d, owing to the use of the glass, the gauze, being no longer required to give light, could be made much finer, and even doubled and trebled. The Museler lamp differs from the Clanny only in having a chimney in its interior just above the flame. There were two objections to the Clanny lamps—viz., the liability of the glass to fracture on being heated, from a drop of water falling upon it in this state, and also its liability to fracture from mehcani-

cal causes. To remedy these defects as far as possible, a lamp has been invented by Dr. Glover. Instead of the single glass cylinder of the Clanny lamp, a double cylinder was used. The outer cylinder was a quarter of an inch thick, the inner one a good stout glass, a full eighth of an inch thick. The air to feed the flame entered at the top of both, through wire-gauze, and passed downward between them, entering the inner cylinder through gauze. The double cylinder, kept packed as it were together by the gauze, was thus much stronger than a single one would be; and if either cylinder be broken, the lamp was still a safe lamp. The current between the glasses kept the outer cylinder cool, so that it could always be held in the hand, while a Museler or Clanny got soon so hot that it would burn the flesh. The light was even superior to the Clanny, owing probably to the more perfect combustion, the air entering the inner cylinder at the bottom.

IMPROVEMENTS IN FIRE-ARMS.

Important experiments with new artillery have recently been made in England, in the presence of military and naval commanders. The practice commenced with a sixty-eight pounder gun, ten feet long, and weighing 95 cwt., on Lancaster's principle of the bore, being oval instead of round, which gives the largest guns all the advantages possessed by the best rifle, when shot or shells of a particular description are used. Excellent practice, it is stated, can be made with rifles at considerable ranges; but until the experiments with Lancaster's oval guns or egg-shaped shells, correct aim could not be taken at the astonishing distance of 5,000 yards, the range of the practice with Lancaster's invention. The long period which elapsed during the flight of the destructive projectile, weighing upward of 88 pounds, owing to its elongated form, caused, according to the account given, a feeling of great suspense; but when it fell at a distance of 5,000 yards, and in no instance did the shells fall wide or short of the target, the spot where it fell and burst presented the appearance of the eruption of a volcano, the sand being raised to a great height in the air. Experiments were also carried on with Moorsom's shells at 3,000 yards, and the practice with them and with shot is described as very good. Several other guns have been made of smaller bores, on Lancaster's principle, for the purpose of carrying on experiments with them.

During the past year, the United States War Department have ordered Maynard's primer and fixtures to be substituted in place of the percussion lock on all muskets hereafter made at the national armories, as also on a part of the old muskets now on hand at the different depositories. Thus the metallic cap, which was of itself a great improvement, is superseded by a still greater one, and will soon go out of use on all fire-arms.

An improved rifle has recently been invented by Mr. Durell Greene, of Cambridge. Its peculiar excellences consist in its simplicity, in the safety of all its movable parts from the action of the powder, in the superlative

ease with which it can be cleaned, and, above all, in its arrangement for making absolutely impossible the escape of gas at the joint between the barrel and the breech. This latter is accomplished by a "self-adjusting thimble," which is forced and held upon its seat in the breech-piece by the reaction of the explosion.

HOW GUNS ARE SPIKED.

A correspondent of the *Morning Herald* says: "Spikes are about four inches long, and of the dimensions of a tobacco pipe; the head flat; a barb at the point acts as a spring, which is naturally pressed to the shaft upon being forced into the touch-hole. Upon reaching the chamber of the gun, it resumes its position, and it is impossible to withdraw it. It can only be got out by drilling—no easy task, as they are made of the hardest steel; and being also somewhat loose in the touch-hole, there is much difficulty in making a drill bite as effectually as it should do. Its application is the work of a moment, a single tap on the flat head with the palm of the hand sufficing. This can be easily done, even if it is ever so dark."

NEW GREEK FIRE.

The war in the East has stimulated the zeal of those in Europe who are interested in improving the art of destruction. Projects the most remarkable and curious are proposed. Being persuaded that one of the means of preserving peace to humanity consists in perfecting our methods of destroying life, and not desiring, in this respect, that one nation should be more favored than others, we mention here some of the projects which rest on serious principles.

The Greek fire has, at different times, engaged attention, without its being exactly known in what it consists. In 1755, a goldsmith of Paris, named Dupré, discovered an inflammable liquid which burned under water. Louis XV. allowed him to make experiments in the canal at Versailles, and then in different seaports, to try the power of the liquid in setting vessels on fire. It is said the results produced were terrific. However, the king believed it his duty to refuse the advantages which the invention promised. He withheld Dupré from publishing his discovery, and gave him a pension. Dupré died, and carried off his secret.

In the month of April last, the photographer, Niepce de St. Victor, while studying benzine as an ingredient of a varnish, observed that this carburet—which is very inflammable in the open air, and at a low temperature, by the simple contact of a small flame, while being insoluble in water, and having a density of 85°—has, eminently, the property of burning upon water. He then remarked, that on throwing on water some benzine containing a fragment of potassium, or of phosphuret of calcium,

either of these substances set fire promptly to the benzine, by becoming inflamed through contact with water.

In two experiments, made each time with 300 grammes of benzine, and half a gramme of potassium, contained in glass vessels, the breaking of these vessels, as they floated on the water, caused the benzine to spread over a large surface; the potassium taking fire, produced an immense flame, which was very hot, and continued for about one minute, notwithstanding a strong wind in one case, and a smart shower of rain in the second.

By request of the Minister of War, M. Niepce undertook to examine into liquids susceptible of burning when used in the interior of hollow projectiles. He set himself at work, and obtained the following results: A mixture consisting of three parts of benzine, and one of sulphuret of carbon, being put into a hand grenade, previously heated to a temperature below that of boiling water, produced a disengagement of vapor, which took fire on contact with a small flame; and a fine jet of flame was obtained, much less smoky than that of pure benzine, and which continued to burn until the whole was consumed. For heating this hollow projectile, either a moment's immersion in boiling water, or contact with burning coals, may be employed. This mixture of benzine and sulphuret of carbon, of the proportions mentioned, floats on water, and its flame has remarkable burning properties when the sulphuret has some phosphorus in solution; and it is proposed to use it in setting fire to wood. Oil of naptha and oil of petroleum, highly rectified, are nearly as inflammable as benzine, and burn on water as readily; but their flames are not so hot. The oil of petroleum, benzine, and sulphuret of carbon, as they are not expensive, it is proposed to use in war, either for burning an enemy's vessel, or for defending a place.

Coupled Cannons.—This is another weapon of war, the effects of which may be terrible. Two cannon have the same breech, and diverge at a given angle; they have a common charge of powder, a single touch-hole and a single cap. In each of these cannons, which are accurately bored and polished, a piston of a cylindrical form is fitted, having the same caliber as the cannon, carefully turned, polished and greased. These two pistons are united together by an iron cord or wire, when used with a musket, or an iron chain from a meter to a hundred meters in length, when with cannon. These pistons serve as projectiles; when fired, they straighten the chain between them, and flying through the air, they sweep every thing before them.—*Silliman's Journal, Paris Correspondence.*

THE COURAGE OF SCIENCE.

Courage in the battle-field is celebrated in history and in song, but little is said of the courage exhibited in pursuing scientific investigations, though often displaying more real elements of bravery than ever were called into action in war. It is said that when Arago and Dulong were employed

by the French Government to make experiments upon the subject of the construction and safety of steam boilers, the task executed by the two philosophers was one of as much danger as difficulty. The bursting of boilers, to which they were constantly exposed in a limited locality, was more hazardous than that of shells upon a battle-field; and while military officers who assisted them—men of tried courage in the conflict—grew pale and fled from the scene, the savans proceeded coolly to make their calculations, and observe the temperature and pressure upon boilers almost at the very point of explosion.

PRICE OF SCENTS.

Piesse, in his annals of chemistry, says:—"The wealth of England is aptly illustrated by showing what Britannia spends, and the duty she pays to the Exchequer, for the mere pleasure of perfuming her handkerchief. As flowers, for the sake of their perfumes, are on the continent principally cultivated for trade purposes, the odors derived from them, when imported into this country, in the form of essential oils, are taxed with a small duty of 1s. per pound, and are found to yield a revenue of just £12,000 per annum. The duty upon Eau-de Cologne, imported in the year 1852, was, in round numbers, £10,000, being 1s. per bottle upon 200,000 flagons imported. The duty upon the spirits used in the manufacture of perfumery at home is at least £20,000, making a total of £42,000 per annum to the revenue, independent of the tax upon snuff, which some of the ancient Britons indulge their noses with. If £42,000 represent the small tax upon perfuming substances for one year, ten times that amount is the very lowest estimate which can be put upon the articles as their average retail cost. By these calculations (and they are quite within the mark) we discover that Britannia spends £420,000 (about $2,000,000) a year in perfumery."

MANUFACTURE OF PARAFFINE OIL.

By the *Edinburgh Witness*, we learn that at a lawsuit lately prosecuted in London, one of the parties, James Young, of Bathgate, on being sworn, deposed, that "he manufactured and sold at the rate of 8,000 gallons a week" of the Paraffine oil, which is procured from the Torbanehill new mineral. 8,000 gallons a week are 416,000 gallons a year, and accordingly Mr. Young's counsel, Mr. Bramwell, stated that his client sold (in round numbers) "400,000 gallons of this oil yearly," Mr. Bramwell adding, "at 5s. per gallon." That is, Mr. Young stated, while his counsel repeated the statement, that from the chemical works near Bathgate, which prepare the Paraffine oil procured from the Torbanehill mineral, there are sold of that valuable oil £100,000 (nearly $500,000) worth yearly, and it is to be borne in mind that the greater portion of this very large yearly sum is *clear profit*. It was also added, that Mr. Young was only one of

many parties in Europe who ordered and obtained this mineral for making oil and producing gas. This mineral is only obtained from a small district in Scotland, and, from the foregoing, some idea of its immense value, in a commercial point of view, may be obtained.

IMPROVEMENTS IN THE PREPARATION OF OILS.

Although gas made from coals is coming into more general use in our cities, &c., thus doing away with the necessity of using oil, still the demand for oil is becoming greater every day. Enormous quantities of it are now being used on all our railroads for lubrication, thus entailing a great working expense on such systems of travel. Any discovery therefore to increase the quantity, improve it, or render it cheaper, becomes of great importance to the community—for the people pay for all these things. We have therefore selected the two following specifications of recent foreign patents, granted for manufacturing oil and lubricating materials :—

Treating Oil Matters.—G. F. Wilson, of London, patentee. This invention consists in diminishing or removing the smell and color from the oily matters that are produced by the destructive distillation of resin, and in combining them with the oleine of palm and other neutral oils. The resin oily matters are distilled, or repeatedly distilled, with the air excluded—the matters, in some cases, being treated with powerful agents, such as sulphuric acid, before this distillation ; or they are exposed to heat, to drive off their more volatile part. The purified resin oily matters are mixed with the other oily matters by means of agitation or boiling up with free steam.

In carrying out his invention, the patentee has recourse to a preparation for mixing the resin oil with the oleine of palm oil and other neutral oils. The resin oil is first caused to be heated for about four hours, in a close vessel, by means of heated steam—keeping the temperature to about 350 deg. Fahrenheit; and it is then to be distilled with the air excluded. According to the state of purity desired to be obtained, the distillation is to be performed again and again ; and, for this purpose, steam, heated to a high degree after it leaves the steam-boiler, is employed, as is well understood. If the resin oil be very impure, about two pounds of sulphuric acid are stirred into 112 pounds of resin oil. The same is then to be washed in water, and submitted to the process of heat.

Having thus prepared the resin oil, it is to be mixed with a neutral oil ; and, for this purpose, the oleine of palm oil is preferred. The best mixture will be found to be in about equal quantities,—but this may be varied; and, in order intimately to mix these matters or oils, they are boiled by the aid of free steam, by which a most intimate admixture is effected ; and such combined oils will be found very useful for lubricating heavy machinery.

Lubricating Materials.—François Monfrant, of Paris, patentee. This invention consists in the employment, for the manufacture of lubricating materials of all fatty oils, (with the exception of coleseed oil,) which are dis-acidified by means of milk, and are then caused to blend and intermix with fat or a fatty body, by means of resin or a resinous composition.

In preparing the said lubricating materials, the patentee employs a large boiler or heating vessel, heated either by fire, or by steam, or hot air, or otherwise. In this vessel, the oil to be operated on is placed, and heated to such a temperature that the hand can just bear it when immersed. The lard or other solid fatty body is then added, (care being taken to stir the mixture well with a spatula from this time to the end of the operation,) and also resin of the ordinary description, or resinous body, in the proportions necessary to produce the several compositions hereinafter specified, or other like proportions. When these two bodies are perfectly melted, and an intimate commixture has taken place, pure fresh milk is added, in the proportion of at least two pints for every 100 kilogrammes (220 lbs. about) of oil; and the greater the impurity of the oil, the larger must be the proportion of milk added to it. In the event of milk not being procurable, the same proportion of albumenized water, (prepared by adding the white of one egg to a pint of water,) or of alkaline water, containing five grammes,) (three and one-fourth dwts. of crystals of sub carbonate of soda to a pint of water,) or even water alone may be used; but milk is, in all cases, to be preferred. The mixture is allowed to be heated to boiling, or until the bubbling produced by the evaporation of the aqueous matters has ceased; and, in order to ascertain when the operation has been carried on to a sufficient extent, a slice of new bread is placed in the heating vessel; and, when this well browned, the operation is complete. It must be observed, that the stirring should be continued throughout the operation; and, in the case of the more solid compounds, even after the boiling is completely finished. When the operation is terminated, as has just been described, the mixture is allowed to repose for several hours, and is then drawn off, before packing it for storage or use, by means of a hand-pump or a common syphon. The results of the different operations described are, that, by the boiling, all the moisture of the milk, and other foreign bodies, is entirely dissipated as vapor; and that the acid principles of these substances, combined with the casein of the milk, are rendered insoluble and precipitated, while the oil, separated from the deposit which they form, contains no acid, and the deposit itself is, in some measure, carbonized, and is easily removed from the vessel. All the products, by being boiled together, are thoroughly incorporated; so that there is no danger of the lard and oil becoming separated,—a result to which the resin or resinous body undoubtedly contributes. If the operation is to be carried on continuously, it will be needful to have tinned iron vessels, into which the clear contents of the boiler can be transferred, to cool and settle before being packed away.

No. 1. Compound for the finer carriage-work, &c. Resin, two and a half per cent. of the quantity of oil. Lard, 50 to 75 per cent. of the quantity of oil, according to the degree of solidity required.

No. 2. Compound for copper, steel, fire-arms, the more delicate kinds of machinery, &c. Resin, none; but, instead of it, two per cent. of common yellow wax. Lard, 25 to 50 per cent. of the oil employed.

No. 3. Compound for lubricating oil for machinery. Resin, two and a half per cent. of the oil employed. Lard, five per cent.

No. 4. Compound for the woollen manufacture, &c. Resin, none. Lard, three per cent. of the oil employed; but, for this purpose, it is indispensable that the lard should be quite fresh.

No. 5. Compound for paint, oil, &c. Resin, one per cent. of the oil employed. Lard, two per cent.

As before observed, these proportions may be greatly varied. The more lard used, the harder will be the compound. The weather also affects the proportions to be used, and more lard must be employed in summer than in winter, to produce a like effect. The lard may be composed of half hog's lard and half mutton or other suet or fatty matter. The lard should be freed from all skin, &c., and cut into small pieces; and it is better also to remove from it any portions of fleshy matter that may be mixed with it; and if the fatty bodies employed, whether lard, mutton suet, beef suet, or other fatty matter, are used in the raw state, they should be first partly melted, before being added to the mixture in the heating vessel, by any of the means ordinarily adopted for such purpose. The products, obtained as before mentioned, can be employed with advantage to replace all the oils employed as lubricators, such as animal oils, lard oil, olive oil, &c. They possess, moreover, the merit of being perfectly unctuous, and of containing no kind of acid; they do not act prejudicially on metals, nor form any residuum through friction; they neither turn rancid from age, nor do they harden from contact with the air; and, lastly, their component parts do not separate from each other, but continue always in intimate commixture.—*Newton's London Journal.*

IMPROVEMENT IN THE MANUFACTURE OF CANDLES.

F. Capiccioni, of London, patentee. When the tallow for making the candles is melted in the kettle, about one seven-thousandth of its quantity by weight, of the acetate of lead, is added, and well stirred among the whole for fifteen minutes. The heat is then lowered, but the tallow is still retained in a liquid state. About one thousandth part by weight, of turpentine, and a little of any of the perfumed resins, are then thrown in and all well stirred until the whole are thoroughly incorporated together; this takes about two hours, one hour for stirring, and one hour of rest for the uncombined impurities to settle to the bottom. The acetate of lead, it is said, makes the tallow hard, and much superior to tallow not so treated; and upon the whole, the composition makes very superior candles.

EXTRACTING JUICE FROM SUGAR CANE.

Messrs. Manifold and Lowndes, patentees, Liverpool. The patent obtained is simply for reducing the cane into very minute pieces, then subjecting these pieces to the action of steam in close vessels, and after this pressing out the juice in a hydrostatic press. The sugar cane is reduced to fine pieces, like dye-wood chips, by a series of circular saws.

COLORATION OF HORN.

The following is from the "Polytechnisches Centralblatt," by Prof. A. Lindner, (German): The process employed in France to stain horn in imitation of tortoise-shell, by which a fiery-red color is produced, which is exceedingly agreeable by transmitted light, is quite different from the old method with lime, soda, and red lead. The horn is first prepared by soaking in dilute nitric acid, consisting of one part of acid and three of water, at a temperature of from 88 to 100 degrees Fahr. It is then treated with a mixture, consisting of one part of fresh burnt lime, two parts of carbonate of soda, and one part of white lead, for not more than from ten to fifteen minutes, in order that the spots should only assume a yellowish brown tint, and not a dark brown. The pieces of horn are now washed with water, and wiped from adhering moisture with a cloth, and introduced into a cold bath, consisting of a decoction of Brazil wood, marking 10 degrees of Baume's hydrometer, and one part of caustic soda, marked 20 degrees. As soon as the color is properly developed, it is to be removed and washed with water, and carefully pressed between cloths, and laid aside from 12 to 16 hours, and then polished. The decoction of dye-wood may be made by boiling one pound of the Brazil wood in two to three quarts of water, and the caustic soda may be obtained from any soap-boiler, or it may be produced by heating a solution of carbonate of soda to the boiling point, and adding slaked lime in powder, until a drop of the liquid, on being filtered, does not effervesce, and setting it aside, carefully covered, until the sediment has deposited. If a little oxide of zinc be added to the white lead employed as a mordant, bluish-red shades will be obtained, while salts of tin give fine scarlet tints. Archil may be used instead of the dye-woods, and still finer tints may be produced with cochineal. The characteristic feature of this process is the use of the caustic soda in the dye-bath; and this fact accounts for Prof. Wagner not having been able to succeed in staining horn with any vegetable or animal dyeing material.

SAL-AMMONIAC FROM GAS WORKS.

The Industrial Society of Mulhausen offers, annually, a number of prizes for inventions and improvements made during the year: and it

also offers a prize to those who introduce a new branch of industry into the department of the Haut-Rhine. This last prize was taken by MM. Moerhlin and Stoll, who manufacture sal-ammoniac from the ammoniacal liquid of gas works. The main difficulty in the operation consists in separating the tar-like material which it contains. The following is the process adopted :—

The ammoniacal liquid is mixed with slaked lime; then submitted to distillation in a boiler heated by steam; the parts volatilized pass into a worm, in which the larger part of the tar is deposited; the ammonia passes on into a Wolff's apparatus, where it leaves the foreign substances present, and finally is carried into cold water, where it is condensed. In this state it is nearly free from its impurities; it is neutralized with chlorohydric acid, and evaporated in a lead boiler. As it deposits, it is withdrawn by means of a wooden rake; it is allowed to drain, and then introduced into a brick mould, and subjected to strong pressure. Blocks of sal-ammoniac are thus obtained, which are dried in an oven heated by part of the heat furnished by the evaporating furnace.

IMPROVEMENTS IN PAVING.

Messrs. Parker & Co., Engineers, England, have recently introduced a novel system of construction for the pavement of roads, bridges, &c. Proceeding on the principle that the inequalities in the best of pavements are first caused by the partial collapse or sinking of the foundation, or substrata, they have to a certain extent rendered the finished portion of the road independent of the homogeneity and solidity of the concrete beneath. The plan consists in casting in sections of three feet square a series of iron boxes, beds, or chambers, eight inches long, three broad, and four deep, into each of which a block of wood is placed, with the grain in a vertical position, or a block of granite, made to fit with moderate exactness, and standing about two inches above the iron framework. By this arrangement the total number of sectors being made to break joint, and firmly keyed together, gives great solidity, avoids all tendency to partial sinking in holes, secures a good foot-hold for the horse, whether gravel is used as an upper casting or not; and as one or more blocks, more soft than others, show signs of wear or decay, they may be instantly and with great facility removed and replaced by others. Another peculiar feature may be noticed, which will prove a source of economy; it is proposed to make the compartments for streets of the greatest thoroughfare the deepest, and for secondary streets less deep, and for third class more shallow still. By this means, when the blocks are so worn as to require removal in a first-class street, they may be removed to another street.—*London Mining Journal.*

TRIALS OF REAPERS.

A trial for a premium of $1,500 offered by the State Agricultural Society of Illinois took place during the past season at Belvidere, in that State, between Manney's Reaper, and Atkin's Self-Raking Reaper, to test their respective merits. The last-named reaper is distinguished in the report as Wright's, the name of the manufacturer. The trial lasted several days, and the report of the umpires gives the following as some of the results :—

Wright cut 20 22-100 acres, in 12 hours and 55 minutes.

Manney cut 20 22-100 acres, in 10 hours and 3 minutes.

Time consumed in reaping, binding, and shocking :—

Wright's first field, 3 37-100 acres, bound in 18 hours and 25 minutes.

Wright's second field, 4 31-100 acres, bound in 25 hours and 30 minutes. Shocked in 4 hours 38½ minutes.

Manney's first field, 3 89-100 acres. Raked and bound in 25 hours and 47 minutes. (This included the time of the raker who stands on the machine.) Shocked in 4 hours and 40 minutes.

The umpires refused to decide between the two reapers, declaring the contest so close as to render it impossible to say which was the best.

Russell's Mowing Machine.—In this machine the cutting bar is attached to the frame of a pair of small cart wheels, and the motion given to the cutters by a cam driven by cogs on the driving wheel, working into a small pinion, so that the machinery has the smallest possible amount of friction. The cutting is different from any other: without crank motion, the bar that holds the knives only sliding 2¼ inches, and yet the knives each have a drawing cut of 1¼ inch, and are so fixed that, when one end is dull, they can be changed end for end in five minutes.

ARTIFICIAL RESPIRATION.

Among recent English inventions, Dr. Marcet's apparatus for artificial respiration promises to be useful, as it has the advantage over other contrivances of the same kind, of being self-acting. It has a double cylinder into which air is compressed; and each by an alternate filling and discharge, with the end of a slender tube inserted into one of the nostrils, causes the lungs to go through the process of expiration and inspiration. It has been tried on asphyxiated dogs with perfect success, and there remains now to test its capabilities on human beings.

PAPER AND PAPER MAKING.

The enormously increased consumption of rags and other materials used in the manufacture of paper, with the consequent increased scarcity of the raw material, and the enhancement of the price of paper, have caused much attention to be given to this subject, both in England and

the United States, during the past season. Efforts have accordingly been made to introduce new materials to serve as paper stock, to improve the method of working old materials, and to diminish the cost of the mechanical operations. The cause of the scarcity of paper-stock, in spite of an increased demand, would appear to depend on the circumstance, that the raw material of paper making is, in reality, the product of the wear and tear of a substance of very advanced manufacture, and depending for its quantity on the collateral causes which produce a greater or less activity in the latter. Hence, the stoppage or partial suspension of cotton and other textile manufactures is sufficient to account for occasional, and especially for local, scarcity.

It would appear, also, that, apart from occasional depressions of the manufactures, or the wear and tear of which the raw material of paper chiefly depends, the demands of the paper makers have been greater than can be supplied by the less increased rate of consumption of the manufactured products. While this has been the case, other consumers of the raw material have come into existence, railroads and steamboats now exhausting a very large quantity of cotton and other waste for wiping machinery.

The disadvantage of the raw material of paper making being dependent upon manufactures, having no immediate relation to its supply and demand, and the fact, also, that the growing thirst for literature is at a greater rate than the increase in the manufacture of cotton and flax, seem to furnish adequate reasons why the supply of rags does not meet the increased demand.

Before noticing the various improvements that have recently been brought forward or suggested, let us glance at the present actual condition of the business of paper making in the United States.

We find that there are, in the United States, 750 paper-mills in actual operation. Allowing 4 engines to each mill, and calculating that each engine will make 300 pounds of paper a day, the quantity of paper made in the year will be as follows:—

Number of mills, 750; number of engines, 3,000; number of pounds of paper per day, 900,000; number of pounds of paper in the year, allowing 300 days to the year, 270,000,000; value of this paper, at 10 cents a pound, $27,000,000.

It is estimated that one and a half pounds of rags are required to make one pound of paper. Adopting these data, we find that 405,000,000 pounds of rags are consumed in one year; their value, at 4 cents a pound, being $16,200,000.

The cost of labor is one and a quarter cents upon each pound of paper manufactured, and is, therefore, $3,375,000 a year; and the cost of labor and rags united is $19,575,000 a year.

The cost of manufacturing, aside from rags and labor, estimated from adding together the cost of felts, wire-cloth, bleaching powders, fuel, machinery, interest and fixed capital, insurance expenses, &c., we find to be

$4,050,000. Adding this to the cost of rags and labor, we find that $23,-625,000 is the total cost of manufacturing paper worth $27,000,000, a measure of profit by no means unreasonable, and which might even be considered small, were not the manufacture comparatively free from those sudden changes that affect the manufacture of cloth and metals.

Light as we may esteem it, there are few branches of business of more importance than the rag trade. No other country in the world, strange to say, is more dependent upon rags than the United States; and this is, in a great measure, attributable to the immense consumption of paper in the publication of newspapers, magazines, and works of all kinds, besides what is used for commercial and mercantile purposes.

The following table shows the quantities of rags imported into the United States during the years 1852 and '53, the sources from whence obtained, with their value:—

	1852.		1853.	
	No. lbs.	Value.	No. lbs.	Value.
Danish West Indies,	15,250	$850	—	—
Hanse Towns,	1,088,668	27,880	2,103,331	$61,259
England,	1,617,359	39,066	2,666,005	74,175
Scotland,	431,619	14,009	1,573.481	77,086
British West Indies,	197.600	3 482	161,332	4,161
British American Colonies,	186,210	3,613	172,830	3,846
Canada,	488,095	10,116	801,971	15,653
France on the Atlantic,	—	—	810	18
Teneriffe and other Canaries,	1,380	41	31,016	523
Italy,	7,161,301	271,572	4,301,127	179,811
Sicily,	1,889,685	60,277	1,848,279	76 689
Trieste and other Austrian ports,	2,161,938	113,352	3,428,441	186,358
Turkey, Levant, etc.,	1,445,625	30.551	882.053	17,917
Hayti,	25,888	243	7,496	169
Dutch West Indies,	940	26	—	—
Malta,	213.082	6,423	—	—
Spain on the Mediterranean,	17,998	542	—	—
Cuba,	222,565	4,804	253,976	8,288
Other Spanish West Indies,	—	—	800	20
Sardinia,	115,637	4,856	301,287	10,739
Russia,	47,853	1,901	97,170	3,748
Gibraltar,	37,702	1,868	—	—
France on the Mediterranean,	25.534	593	—	—
Tuscany,	892.029	30,236	4,291,859	261,293
Chili,	4,500	138	38,162	961
Peru,	—	—	4,575	137
Total,	18,288,458	$626,799	22,766,001	982,837

For the four years, 1850, '51, '52, '53, the quantity of rags imported into the United States amounted to 97,846,035 pounds, costing $3,262,000, or about three and a third cents per pound.

In 1850 we imported rags from nineteen countries; in 1852 from thirty-two; which increment seems to have arrived near the ultimate limit, as we were only able to add Peru to the list in 1853.

Italy seems to be the great source of supply. In 1850 we obtained nearly half as many pounds from there as from all other places, while the amount paid exceeded half the whole sum. In 1851, the quantity and

price of Italian rags only exceeded one-third of the amount by a trifle. That is the only year in the four that Prussia and Denmark furnished any rags. Holland, British East Indies, France on the Atlantic, Mexico, are only in the receipts of 1850. Gibraltar and France, on the Mediterranean, only appear in 1852.

The point most worthy of note is the regular falling off in the receipts from Italy from 1850 to '53. Thus we have ten millions, nine millions, seven millions, four millions of pounds per annum. It is this that has driven dealers to scour all other countries likely to afford the necessary supply. In this they succeeded in 1851, gaining a little over five millions of pounds upon the year previous; but the next year they fell back seven and three-quarter millions of pounds; and, notwithstanding the very largely increased demand for paper within four years, the imports of 1853 are only a trifle over two millions of pounds more than 1850. One thing in the above table strikes us as somewhat curious: that is, that we import rags largely from England; and we see by her Custom-House returns, that the imports into that country last year were 9,687 tons—21,698,880 pounds—and her exports 2,462 tons—5,414,880 pounds. Our imports from England the same year were 2,666,005 pounds.

The cost per pound, of our imported rags, has been as follows: 1850, 3 61-100c.; 1851, 3 46-100c.; 1852, 3 42-100c.; 1853, 3 46-100.

The following table shows the amount of our exports and imports of paper, and imports of rags, from 1838 to 1850:—

	Exports Paper.	Imports Paper.	Imports Rags.
1838.	$94,335	$164,179	$465.448
1839.	80,149	186,418	588,318
1840.	76,957	146.790	564.689
1841.	83,483	60.193	496,227
1842	69,862	92,771	468,220
1843.	51,391	19,997	* 79.853
1844.	83.108	104,648	295,586
1845.	106,190	98,009	421,080
1846.	124,597	194,220	304,216
1847.	88.731	195,571	385,397
1848.	78.507	415,668	626,607
1849.	86,827	395,773	524.755
1850.	99,696	496,563	748,707

* Duty began to be enforced on rags, 1843.

In 1853, there were 304 paper-mills at work in England, 48 in Scotland, and 28 in Ireland. The duty (three half pence per pound) amounted to upwards of £925,000, so that the annual value of paper manufactured in those countries could not be less than £3,700,000, the average value of paper being estimated at sixpence per pound.

France, with a population of 36,000,000, turns annually into paper 105,000 tons of rags. Of these, 6,000 tons are imported. In that country the exportation of rags has been prohibited by law since 1850.

England, with 28,000,000 inhabitants, requires yearly 90,000 tons of rags, 15,000 of which are imported.

The consumption of paper in the United States is said to be that of England and France added together. There are used here 6,000 tons of straw for wrapping paper and paste boards, and during the last few years the importation of rags has averaged 10,000 tons. In 1850, Italy sent to this country 5,000 tons, and in 1853 only 2,000, this deficiency being compensated by importation from new places, such as Russia, Chili, and Peru.

The above clearly shows that industrious or rich nations require more paper than they can make with their own rags, and that the deficiency of home supply is made up by purchase from their less advanced neighbors. But progress is going on every where very rapidly, and every where, as it seems to be the case with Italy, the exportation will go on diminishing.

Many attempts have been made to furnish new raw materials for paper, but hitherto with only partial success. The failure generally results from one or more of three causes. (a.) Some fibres require so much cost to bring them to the state in which they are offered to paper makers, in the form of rags or cotton waste, that in point of economy they cannot enter into competition with the latter. (b.) Certain fibres lose so much weight in bringing them to this state, that they cease to be economical. (c.) Certain fibres, which are well adapted on account of their texture for the paper trade, present so many difficulties in bleaching them as to render them unfit for white paper.

In the United States, if new materials are to be introduced for the manufacture of paper, the difficulties to be overcome are for the most part chemical, and not mechanical, in their nature. The mechanical departments of the manufacture of paper have attained to an astonishing degree of perfection, until the whole process, from the time when the boiled rags enter the engines until they are reproduced as paper, is almost automatic. But the chemistry of the operation, the cleaning, the boiling, the sizing, and the bleaching, are yet rude and imperfect. And what is true of paper-making, is true of almost every other branch of manufacturing in this country. The departments in which progress has been made are mechanical, and it is only here that a high degree of perfection has been attained to. And this result is a natural one; our mills and our workshops are filled and surrounded with an intelligent population, trained by example from their youth up, and continually stimulated to invent. Their mechanical education, acquired almost instinctively, makes them ready to perceive and appreciate mechanical principles, and their minds and energies are constantly directed towards the economization of power, to the application of force by new methods and for new purposes, or for the improving and perfecting of old plans and arrangements. But with chemistry it is altogether different. Its principles cannot be acquired by observation, but only by long study and practical working. The science itself is regarded by many as a collection of unsystematized facts, and to some extent this is undoubtedly

true. Therefore it is that the chemical department of American manufacturing is far inferior to the mechanical. Until within a recent period, there has been no applied chemistry in the United States—our processes are foreign, learned from foreign books, and our chemical artisans are also foreigners. And here it may be remarked, that chemical improvements of practical value, originating in Europe, do not find their way into text-books and magazines for the information of the many until they have been long known to private manufacturers, or have been replaced by other improvements of greater value.

Empirical experiment rarely leads to success in chemistry. The materials from which paper can be manufactured exist in abundance; but this avails nothing so long as the cost of converting them into paper exceeds a certain limit. The attempt to convert straw into white paper is an example. That it can be effected is no question, but that it can be effected profitably is yet to be demonstrated. The process as ordinarily pursued is a simple one, and not covered by any patent. The heads, grain, and all knots and joints must be removed by chopping and winnowing; a process involving considerable expense, and much loss in weight. The silica investing the straw, together with much gum and coloring matter, must be then removed by the action of a caustic alkali. The alkali effects the separation of these substances by uniting with them and forming soluble silicate of soda, or potash and soluble soaps. It is claimed that a large part of the alkali so expended may be recovered by evaporating the residuary liquors and calcining the deposited matters. Theoretically this can be done; practically, with economy, it cannot. In these operations, and in bleaching, the straw suffers a depreciation in weight of at least 60 per cent., and is then inferior to rag stock. From long and careful experience, we are convinced that white paper cannot profitably be manufactured from straw, or analogous materials, by any of the processes now in use.

The direction in which improvements in the manufacture of paper are to be sought for is in diminishing the waste which the ordinary stocks now used experience in their manufacture, in availing ourselves of the refuse fibres of the hemp and flax plants, (thousands of tons of which are now annually wasted in the United States and India,) and in discovering a method of bleaching and working the fibres of various endogenous plants, as manilla, sisal hemp, and the fibre of the corchorus (gunny), the Sun Hemp (*Crotalaria*), and the "*Coir*" fibre.

The ordinary method of cleaning rags and "cotton waste" from the dirt and other impurities, is by boiling them under steam pressure, with a mixture of caustic lime and a little soda-ash, for twelve to twenty-four hours. In this treatment, the most violent and powerful among chemical reactions, the lime is often used in the solid, or pasty state, as well as the soda-ash; by which no small portion of the cellulose is absolutely destroyed, converted in soluble compounds, to be washed away in the first engine. By this treatment some varieties of rags lose fifty per cent. in weight after washing, and on ordinary cotton waste the depreciation is

nearly as great. In the last case it should be remembered that the material is new, possessing its full strength, and has not been subject to depreciation by use. Here then, in these instances, one-half of the material is needlessly destroyed at the commencement of the operation.

The only valuable improvement recently brought out for the improvement of paper-making, and which is designed to meet and obviate the difficulty above alluded to, is embraced in a patent granted, in 1854, to David A. Wells, of Massachusetts. His improvement, based upon some of the simplest and most beautiful of chemical reactions, is as follows:— It has been found that a caustic alkali, in solution, if kept below a certain limit indicated by the hydrometer, is capable of dissolving and holding in solution caustic lime, or other alkaline earths.

If a certain limit of strength be exceeded, the alkaline earth is precipitated. Remembering that potash and soda form, with gum, grease, oils, coloring matters generally, and silicia, soluble salts, and that the alkaline earths form with the same substances insoluble salts, let us suppose a solution of an alkali containing lime, as described, to act on a mass of material, as cotton-waste, for the purpose of cleansing the same. The solution being heated, the alkali attacks the grease, and becomes converted into soap. In ordinary cases, the operation would here terminate. The atom of alkali, joined to the atom of grease, is inert to remove and render soluble any other atom of grease, and is therefore lost. But when the caustic alkali has lime dissolved with it, the case is different. No sooner has the alkali seized and liberated from its combination with the fibres one atom of grease, than the lime, by virtue of its forming with the fat acids insoluble salts, takes grease from the alkali, leaving the alkaline particle to repeat its work, and again be renewed. The result is, that weak alkaline solutions can thus be made to do the work of strong ones, and the expense falls almost wholly on the cheap alkaline earth, leaving the dearer alkali almost untouched and unimpaired.

India as a source of materials for the manufacture of paper.—At the request of the English Board of Trade, Dr. J. Forbes Royle, distinguished for his acquaintance with the vegetable productions of Southern Asia, has published the following information respecting the fibrous materials of India, which may be rendered serviceable for the manufacture of paper:—

"In reply to the reference from the Lords of the Committee of Privy Council for Trade, requiring my opinion respecting increased supplies of raw materials for paper making, I beg to be allowed to observe, that it is a subject on which I have of late been frequently consulted, and have communicated much of the following information:—

The fibrous parts of many lily and aloe-leaved plants have been converted into excellent paper in India, where the fibres of tiliaceous, malvaceous, and leguminous plants are employed for the same purpose—as in the Himalayas, one of the lace bark tribe is similarly employed, and in China one of the mulberry tribe, and the nettle in Holland. I mention these various sources, because plants belonging to the same families as the above

abound in India and other warm countries, and are capable of yielding a very abundant and never-failing supply of sufficiently cheap and very excellent materials for paper making of all kinds. Some may be used without any further process of bleaching, but all are capable of having any color they may possess destroyed by chemical means, as I would not except the jute canvas or gunny bagging, because I have seen specimens of jute of a beautiful silky white, both plain and manufactured into fabrics for furniture, &c., as shown at the East India House. As the Chinese make paper of rice straw and of the young shoots of the bamboo, while the Hindoos make ropes of different grasses, (such as Saccharum Munja and Saccharum Sara,) strong enough for their Persian wheels, as well as for towing lines, it is evident that these, and probably many others, contain a sufficiency of fibrous material for paper making. The cultivated cereals cannot well be turned to much account, for their straw forms the chief food for cattle; but as the country abounds with grass jungles, which are in the autumn of every year burnt down in order that the young blades may spring up and afford pasturage for cattle, it is evident that there are many situations where a sufficiency might be cut down before it has become perfectly dried up, and converted into half-stuff for paper makers.

Of the sedges, also, some are, in India, employed for making ropes, as the Bhabhur or Eriophorum Cannabuium, for making rope bridges for crossing some of the hill torrents. The papyrus, we know, was used by the Egyptians for making their paper, but it was by cutting the material into thin slices and making them adhere together under pressure. But others of the genus, as the Cyperus legetum, are used in India for mat making. As these plants, as well as rushes, grow together in large quantities, it would be quite possible in many places to turn them to profitable account.

Many parts of the world abound in the lily and aloe-leaved plants which have been alluded to above, and of which the leaves contain much easily separable fibrous materials. These belong to the genera Agave, Aloe, Yucca, Sansiviera, Bromelia, and others, all of which abound in white-colored fibres, applicable to various useful purposes, and of which the tow might be used for paper making, and considerable supplies obtained. Paper used to be made from the Sanseniera in Trichinopoly, and some made of the unbleached agave alone, and also mixed with old gunny bass.

Among cultivated plants there is probably nothing so well calculated to yield a large supply of material fit for making paper of almost every quality as the plantain, (Musa Paradisaica,) so extensively cultivated in all tropical countries on account of its fruit, of which the fibre-yielding stems are applied to no useful purpose. The plant, as every one acquainted with tropical countries knows, is common near the poorest huts and in the largest gardens, and is considered to yield by far the largest quantity of nutritious matter. Its fruit in many places supplying the

place of bread, and in composition and nutritious value approaching next nearly to the potato, may, if produced in too large a quantity, be preserved in the same way as figs, or the meal may be separated, as it resembles rice most nearly in composition. Each root-stock throws up from six to eight stems, each of which must be yearly cut down, and will yield from three to four pounds of the fibre fit for textile fabrics, for rope making, or for the manufacture of paper. As the fruit already pays the expenses of the culture, this fibre could be afforded at a cheap rate, as from the nature of the plant, consisting almost only of water and fibre, the latter might easily be separated. One planter calculates that it could be afforded for £19 13*s.* 4*d.* per ton. Some very useful and tough kinds of paper have been made from the plantain, and some of finer quality from the same material in France.

All the plants which have been already mentioned are devoid of true bark, and are called endogenous in structure. Simple pressure between rollers and washing would appear to be sufficient for the separation of the fibres of most of them. But the following families of plants are all possessed of true bark, which requires to be stripped off, usually after the stems have been steeped in water, before their respective fibres can be separated from the rest of the vegetable matter.

The flax plant abounds in fibre, but this is too valuable to be converted into paper. India, however, grows immense quantities of the plant on account of its seed, (linseed,) which is both consumed in the country and exported in enormous quantities ; but nowhere is the fibre turned to any account. This is, no doubt, owing to the climate not favoring the formation of soft and flexible fibre ; but the short fibre which is formed, and might be easily separated, would be valuable for paper making, and might add to the agriculturist's profits without much additional outlay.

So some malvaceous plants are cultivated on account of their fruits being used as articles of diet, as okhra (*hibiscus esculentus*) of the West Indies and of the United States. The *ram-turai* of India is closely allied to it, and is cultivated for the same purposes. Both plants abound in fine flexible fibre, which is not, but might be, easily separated, and afford a considerable supply, especially if the cultivation was extended in the neighborhood of towns. Paper is made from a species of hibiscus in Japan, and hibiscus sabdariffa is cultivated in India on account of its jelly yielding calyxes. Numerous other species of hibiscus, of lida, and of other genera of this family, abound in warm climates ; several are cultivated in different countries, as hibiscus camabinius in India, and lida titiœfolia in China ; more might be so. They grow quickly, and to a large size, and abound in fibrous material of a fine, soft, flexible quality, on which account they might be cultivated with profit, and the tow be useful to the paper maker.

The filiaceæ are likewise remarkable for the abundance and fine quality of fibre which many of them contain. Filia Europa produces the enormous quantities of bass exported from Russia. Corchorus olitorius and

corchorus capsularis, the leaves of both of which are used as a vegetable, yield the large supply of jute imported into this country, as well as the gunny cloth and bass exported even to America. Several species of greivia yield edible fruit, on which account they are cultivated. Others abound in the jungles, and most would yield a valuable fibre, as some of them already do, for commercial purposes. Some paper is made from gunny bass. Some of the leguminosa also abound in valuable fibre. Crotalaria juncea yields the common sunu of India. Sœbania cannibana yields the drauchi of Bengal, while banlirnia racemesa is used for making rope bridges in the Himalayas. The fibre of Parkinsonia aculeata was sent to the exhibition in 1851 expressly as being fitted for paper making; though colorless, it wants strength.

Several plants produce large quantities of a silky cotton-like substance, not applied to any use, such as the silk-cotton tree, the mudar of India, and several species of saccharum, which might be collected where labor is cheap, and would no doubt be well fitted for conversion into pulp for paper.

Among the nettle, the mulberry, and bread fruit tribes of plants, there are many which seem well calculated to yield material for paper making. The Chinese, we know, employ the inner bark of morus, now Bronponetia papyrifera. This, no doubt, produces some of the Chinese paper, which is remarkable for toughness. I believe that the refuse cuttings of the bush cultivation of the mulberry in Bengal might be turned to profitable account. The barks of many stinging (Urtica) and of stingless (Bochmeria) nettles abound in fibres remarkable for strength; the tow of these might be converted into paper stuff, if not required for mixing with wool.

The weeds of tropical countries which grow in such luxuriance, and among which are species of sida, of greivia, of corchorus, of triumfelta, and of many other genera, might all yield an abundance of fibrous material if the refuse of the above cultivated plants was found not to be sufficient. Some simple machinery for separating the fibre would greatly facilitate operations, while the expenses of freight might be diminished by compression, or, as suggested, by packing the material as dunnage; and the cheapness of labor, as of every thing else, in many of these countries, would enable material for paper making to be brought here in great abundance and at a sufficiently cheap rate, if ordinary pains were taken by the consumers in Europe to encourage the planter or colonists of a distant region."

As has been already remarked, it has been found impracticable to convert many of the East India fibres, gunny and manilla, into white paper, on account of the difficulty experienced in bleaching. The cause of this difficulty, as ascertained by a course of careful experiments by the writer, is this: The fibres contain a vegetable acid coloring matter, united to a salt of iron, existing naturally in the plant, and probably set free and changed in character by the course of preparation, and by the decompo-

sition which the fibre undergoes. This acid is probably crenic or something analogous, and as its combining proportion is enormously great compared with that of iron, a small amount of bass, therefore, proves sufficient to saturate it. Under these circumstances, the fibre is as it were artificially dyed with a fast color, bit in with an iron mordant; and until this difficulty is overcome, the bleaching of these materials is next to impossible.

The following are some of the recent improvements in relation to paper making which have appeared during the past season.

The following is an extract from the specification of a patent granted to Messrs. Lavender & Lowe, of Baltimore, for preparing a material for paper from the southern cane :—

We take the article called Reeds, in the Carolinas used for fishing poles, and farther South and West called Cane, and by botanists called the Arundinaria Macrosperma of Michaux. These are first passed through rollers, so as to crush them flat, and cut into convenient lengths of three or four feet, and then laid compactly in a suitable vessel—we prefer a tub or vat of yellow pine plank, because it is a wood not easily affected by acid. Muriatic or sulphuric acid, of a strength of about eighteen degrees Baume, diluted with an equal quantity in weight of water, is then poured upon the cane, enough to cover it. Suffer the cane to remain in this position until fully disintegrated, which is ascertained on trial, by the fibres easily separating and being very tender. The time required for maceration is two or three days. Then draw the acid off for future use; then add cream of lime, or any carbonated or caustic alkali, in quantity sufficient to neutralize the acid absorbed by the cane, with water sufficient to cover it, and let it remain in this alkaline solution ten or twelve hours. Let the solution then be drawn off, and take the cane out carefully as it is tender, and dry it in the most convenient mode. When thoroughly dry, the fibres, though they separate from each other easily, yet retain their original strength and tenacity. Pass the cane then through a brake similar to that used for breaking flax and hemp, and clean it, and it becomes fit for use, and should be put up with the fibres laid out straight and regular, as Kentucky hemp is prepared for market, unless it is put up expressly for paper making, in which case it is unnecessary to use such care in putting it up straight.

Paper from Peat.—J. Lallemand, of Besançon, France, patentee. The inventor first washes the peat thoroughly, to separate all the earthy from the fibrous portions, and then places these latter in a strong caustic lye, where they are suffered to soak for twenty-four hours. They are then removed, and placed for about four hours in a bath of weak, hydrochloric acid, and kept constantly agitated. After this they are washed in clear water, and then placed in a weak alum solution. After this they are bleached with chlorine, and mixed with from five to ten per cent. of rag pulp, and then go through the other common processes for making paper.

A patent for the manufacture of paper from wood has been taken in England, by R. A. Brooman, of London. In this, the machinery preferred to be employed, for the purpose of obtaining the fibres of wood and woody substances, consists of a millstone or millstones, or metal roller, cylinders, or rasps with roughened surfaces, which are caused to act upon blocks or pieces of wood held in a frame, always in the direction of the grain thereof, a current or stream of water being directed on to the stone or other reducing agent immediately before its contact with the wood. A gauge is provided, to prevent the passage with the water of such portions of the wood or woody fibres as may not be sufficiently reduced. The fibres come from the stones, rollers, cylinders, or rasps, in a state of pulp, and are passed through sieves of different gauges, from which they are taken, to be applied to the manufacture of different qualities of paper. The pulp thus obtained may be mixed with rag pulp, and with various other ingredients now employed in the manufacture of paper; and the pulp is subjected to form it into paper. The wood pulp may be bleached by any ordinary process, or by means of the following process: Mix the pulp, in the first place, with a solution of carbonate of soda or soda ash, and subsequently with a solution of alum; the strength of these solutions being regulated by the degree of whiteness required to be given to the pulp. The relative proportions of the two chemical bodies in their respective solutions are about two to one; that is, the quantity of carbonate of soda contained in its solution should be about double the quantity of alum contained in the solution of that salt. The total quantity of both required, is about one-tenth by weight of the pulp operated on.

The patentee claims, first, the manufacture of paper from wood and woody fibres, reduced to fibrous pulp by means of mechanical agents, acting in the direction of the length or grain of the said fibres, and parallel thereto; together with water or other suitable liquid, applied in the manner described. And, second, the particular arrangement of machinery described, for reducing wood to fibrous pulp suitable for the manufacture of paper.

The following notice of another improvement is taken from *Newton's Journal*, George Stiff, of London, patentee :—

In carrying out his invention, the patentee makes use of straw, or grass, "gunny bagging," and "hemp bagging," preferring, however, the employment of straw. When straw, grass, or vegetable fibre of any similar kind is employed, the first process made use of is, to cut the straw or fibre into lengths of about half an inch,—which may be done in a chaff-cutting machine, or any similar apparatus heretofore employed for the purpose; after which, the straw or fibre is winnowed, by any suitable contrivance, in order to separate the knots and other portions of the fibre which could not be readily reduced to the consistency of pulp. The straw or fibre thus treated, or the gunny bagging, or hemp bagging, after having been suitably prepared, is placed in a boiler or vessel, together with a sufficient quantity of clear water to cover the fibre or other material, and

boiled for the space of one or two hours. This boiler or vessel is furnished with partition or diaphram, finely perforated, or composed of gauze or similar material, through which the water may be drained off from the fibre or other material, and carried away through a discharge-pipe, which is brought into connection with the lower surface of the boiler or vessel. After this process, the fibre or other material is to be immersed in lime-water, in the proportion of about 1 cwt. of lime-water to every cwt. of material, and to remain so immersed for the space of about twenty-four hours, the mixture being occasionally stirred. After the expiration of this time, the lime-water is to be drained off, and a fresh solution poured on, which is again drained off as before. When this operation has been continued during about three days, the fibre or other material is to be placed in water, to which alkali has been added, in the proportion of about 10 pounds of alkali to every 1 cwt. of water, and boiled for the space of two or three hours; the alkaline solution is then drained off in the manner before described. After the fibre of the material has been thus treated, it is washed and bleached in the same manner as when bleaching rags; that is to say, by running it into tanks or vessels, with a quantity of chlorine or bleaching powder sufficient to bleach it to that degree of whiteness which is required for the quality of paper to be made. After being thus bleached, the straw, or other fibre or material, may be washed and beaten, and reduced to pulp or half stuff, in the usual manner; and the pulp or half stuff may be converted into such paper as shall be required by the process heretofore in use.

The patentee claims the substitution of lime-water for other alkaline solutions heretofore employed in the maceration of straw, grass, or other vegetable fibre, or gunny bagging, or hemp bagging, used to form the pulp or half stuff, in the manufacture of such descriptions of paper as are produced from the aforesaid materials.—*Newton's London Journal.*

Manufacture of Paper from Cow-dung.—The following communication, by Dr. Lloyd, of England, is published in the Journal of the Society of Arts:—

Attracted to the subject of paper-making by an accidental circumstance, and aware of the very great variety of vegetable substances that have, from time to time, been proposed to be so employed, and of those which are actually in use, wholly or in part, as substitutes for the costly, "filthy rags," I was induced to make trial of the fibre derived from some of our common grasses. Reflecting, too, upon the condition of the fibre of the flax plant having undergone all the destructive chances and changes, during a course from the living plant to the almost decayed fragment of rag, and contemplating the wonderful tenacity and endurance of the fibre in resisting the destructive agency of all the repeated mechanical and chemical operations to which it is subjected up to the period of its becoming fair linen cloth, and afterwards, through the incessant action of wear, and the no less destructive operations of the laundress,—and the transition through the rag-bag to its committal to the paper-mill, in which

the fibre is finally resolved into extreme tenuity ; and observing that the fibre of many plants passes, uninjured, through the alimentary canal of the cow,—I concluded that the straw of the flax plant might be advantageously employed in the manufacture of paper, having previously yielded a considerable amount of nourishment as food for cattle, which, in the ordinary treatment of the plant, is entirely wasted. I accordingly instituted some experiments, both in the use of flax-straw as food for cattle, and in the conversion of the same straw, after its passage through the alimentary canal, into paper.

Assuming the straw of the flax plant to contain the same nitrogenous elements as the seed-vessels, it appeared probable that, when cut into chaff, and mixed in varying proportions, either with the chaff of certain grasses, selected for their strength of texture, as common dog's-tail grass, (*cynosurus cristatus*,) or with that of common hay, it would, in the process of mastication and digestion, yield a considerable portion of flesh-making nutriment; and by the same natural process, all or the greater part of the soluble matter being thus separated, the pure fibre would remain in the excreta, which, being retained in convenient receptacles under the feeding-stalls or boxes, which should be "boarded," or perhaps half-boarded, and the liquid portion being separated by pressure, after a certain degree of dilution with water, would be preserved as manure to be returned to the soil.

We have thus at command a natural and most economical "rag-engine" for the separation and comminution of the fibre in the jaws and teeth of the ruminant machine—a series of macerating vessels in the stomachs and alimentary canal, in which the soluble matters are detached and removed, not as waste, but destined, not only to keep in repair the machine itself, but, by increase of weight, to add most materially to its value.

As the present purpose is not so much to treat of the feeding qualities of flax-straw, or of the value of the liquid portion of the excreta thus obtained for the purposes of manure, but rather to show that a useful and economical paper can be made from the solid portion, it will be sufficient to state, that, in the experiments undertaken last year, the nutritious properties of the flax-straw were very evident, notwithstanding the increased time and labor in chewing the cud of such tough material demanded; and with respect to the value of the liquid manure, nothing need be added to the remark, that its qualities will, of course, greatly depend upon the nature of the food from which it is in part derived; so that, whatever be the value of flax-straw when so used, as compared with other substances, the value of the excreta, as manure, will be in the same proportion. One remark may, however, here be made with respect to the money value of the straw, which, to cultivators, is of prime importance. A good crop of flax, such as spinners would give the best price for, would be too valuable for a farmer to use as food for cattle only; and even in reference to the ultimate use of the fibre, when freed from the soluble,

nutritive matter for paper-making, in the manner here proposed, the cost might, perhaps, be too great at present; but the quality of straw that would be of the highest value for making yarn would not be that which would be preferred for food; and for paper-making, the inferior would, in all probability, be quite as useful. It is a common complaint of persons attempting to grow flax in new districts, that they cannot find a market for it, and consequently many have been deterred from growing this plant by having no use for it, nor being able to sell it advantageously. Now, though the cultivators of flax generally will not be able to derive the full advantage of the proposed novel use of the straw by becoming paper-makers, yet it may oftentimes induce them to decide in favor of its cultivation, to know that both the straw and seed may be used profitably as food, and that an irregular or "ragged" crop, which would be of comparatively little value to sell to the flax-spinner, would still prove remunerative to the grower.

The liquid portion of the cow-dung having been separated by mechanical pressure, and conveyed into tanks, to be from thence distributed upon the land, the solid matter undergoes a washing in water, and is then subjected to the action of steam in closed vessels; it is afterwards allowed to macerate in water for some days, (the length of time varying according to the atmospheric temperature,) so as to admit of a certain degree of fermentation, and again washed, by which means the fibre is more perfectly freed from adventitious matter, which, being present, not only deteriorates the color of the paper, but greatly interferes with its quality in strength and softness. In this state it may be regarded as in the condition of what the manufacturers call "half-stuff;" and so far, the work of the rag-engine has been performed by the living machine; and the material is bleached, by means of some of the ordinary compounds of chlorine, to whatever extent may be desired.

NEW METHOD OF PRESERVING WHEAT.

A Mr. Adams, in a late number of *The Journal of the London Society of Arts*, has made a suggestion for a new kind of granary, by which he thinks that grain may be safely and effectually preserved for any number of years. The great difficulty now is the natural moisture contained in all grain, and which it is never entirely divested of, by exposure to the atmosphere at the common temperature, this being the cause of much of the sour, musty flour found in market.

The following are Mr. Adams's observations upon the subject:—

"There does not seem to be any difficulty in the matter, if we divest ourselves of preconceived ideas of the notion that a granary or grain receptacle must necessarily be a building with a floor or windows more or less multiplied in altitude. We may reason by analogy as to what is the cheapest and most effective means of securing perishable commodities from the action of the atmosphere and vermin. In England we put our

flour in sacks. Brother Jonathan puts his in barrels, which does not thoroughly answer. * * * If Brother Jonathan wishes really to preserve his flour or his 'crackers' undamaged, he makes them thoroughly dry and cool, and hermetially seals them in tin cans. This also is a common process to prevent goods from being damaged at sea.

"There can be no doubt that if we were to put dry wheat in an hermetically sealed tinned case, it might be kept as long as the famed 'mummy wheat' of Egypt. This will readily be admitted, but the expense would be queried. Let us examine into this. A canister is a metallic reservoir; so is a gasometer; so is an iron water-tank in a ship, at a railway station, or elsewhere; and a cubic foot of water-tank on a very large scale will be found to cost very much less than a cubic foot of canister on a small scale. And if a bushel of wheat be more valuable than a bushel of water, it will clearly pay to put wheat in huge canisters of iron. The wheat canister, in short, should be a wrought or cast metal tank of greater or less size, according to the wants of the owner, whether for the farmer's crop or the grain-merchant's stock.

"This tank should be constructed of small parts, connected by screw-bolts, and consequently easily transported from place to place. The internal parts should be galvanized, to prevent rust, and the external part also, if desired. It should be hermetically tight at all the points, and the only opening should be what is called a man-hole—that is to say, a canister-top where the lid goes on, large enough to admit a man. When filled with grain, the top should be put on, the fitting of the edge forming an air-tight joint. Wheat put dry into such a vessel, and without any vermin, would remain wheat any number of years. But an additional advantage to such a reservoir would be an air-pump, by the application of which, for the purpose of exhaustion, any casual vermin would be killed. If the grain were moist, the same air-pump might be used to draw or force a current of warm air through it, to carry off the moisture. By this process, and subsequently keeping out the air, the grain might be preserved for any length of time. As the reservoir would be perfectly air-tight and water-tight, it might be buried in the ground with perfect safety; and thus cellars might be rendered available for granaries, economizing space of comparatively little value. The grain would be easily poured in from the surface; and to discharge it, an Archimedean screw should be used. The size of the reservoir should be proportioned to the locality, and it should hold a specified number of quarters, so as to serve as a measure of quantity, and prevent the expense of meterage. * * * If constructed above the ground, a stair or ladder must communicate with the upper part, and the lower part must be formed like a hopper, for the purpose of discharge. For many farm localities this arrangement might be best, and wheat might be thrashed into grain direct from the field and stored. * * * Granaries of this description would occupy less than one-third the cubic space of those of the ordinary description, and their cost would be less than one-fifth. * * * With this security

for storing safely, a farmer would have less hesitation in sowing great breadths of land. He would not be driven to market under an average value, and might choose his own time for selling. The fear of loss being dispelled, people would buy with less hesitation, and the great food stores of the community would, by a wholesome competition, insure the great mass of the community against a short supply. But as long as uncertainty shall prevail in the storage of grain, so long will it be a perilous trade to those engaged in it, and so long will the food of the community be subject to a very irregular fluctuation of prices. There is nothing difficult in this proposition. It is merely applying existing arrangements to unusual cases. There needs but the practical example to be set by influential people, and the great mass will travel in the same track. To the wealthy agriculturist it will be but the amplification of the principle of the tin-lined corn-bin, that keeps out the rat from the oats of the stable. * * * Were this mode of preserving grain to become general, the facility of ascertaining stocks and crops after reaping would be very great. The granaries being measures of quantity, no hand-measuring would be needed, and the effects of wet harvest weather might be obviated."

CARBONIZATION OF WOOD.

Extensive experiments under the direction of the French Government have recently been made by Mr. Violette on the carbonization of wood. He has found that the carbonization of wood, effected by means of hot steam, commences at 150 deg., centigrade, but that coal gets friable and suited for the manufacture of the finer qualities of gunpowder only when the temperature of the steam reaches 280 deg. At 350 deg. the coal becomes black, but at 1,000 and 1,500 deg. it gets very black, exceedingly compact, and very slightly inflammable. At the temperature when platina melts, it gets so hard that it is difficult to break it; it has a metallic sound, and ceases to burn as soon as it is removed from the flame of a candle; it is then like anthracite. At 280 deg. 40 per cent. of charcoal is obtained; at the highest degree of temperature it yields only 15 per cent. Slow carbonization produces more charcoal than a rapid one. The coal obtained at 270 deg. contains 70 per cent. carbon, 27 water, and 1.6 hydrogen. Charcoal produced at 350 deg., and suited for common cannon powder, contains 77 of carbon, 20 of water, and 2 of hydrogen. From that degree up to 1,500 deg. there is no more water found in the coal, and only few traces of hydrogen. When the steam is admitted into the retort containing wood, he was enabled to produce at 422 deg. charcoal of the same nature as coal carbonated in the ordinary way at 1,200 deg. The steam assists the decomposition of the wood, and carries off all the volatile substances. In closed retorts wood becomes almost fusible, resembling stone coal, but differing from it only in its composition. In closer retorts, at a temperature of 180 degrees, the same kind of coal may be obtained as in a common way at 280 degrees. The absorption of moist-

ure by coal diminishes in proportion to the temperature employed in its carbonization, but its power of conducting heat grows with the higher degree of temperature employed; the power of conducting electricity is also much increased by a higher temperature, and the electric light is more brilliant. In proportion as the density of coal increases, the facility of burning decreases. Coal obtained at a low degree of heat is more inflammable than that carbonized at a higher degree. While coal obtained at a low degree of heat burns at 340 deg., coal for ammunition powder requires 370 deg.; coal made at 1,000 and 1,200 deg. burns only upon tin heated to cherry-red heat. Sulphur burns only at 250 deg., but it occasions the deflagration of saltpetre at 432 deg., while coal produces it at 380 deg. Thus in burning your powder it is the sulphur which first takes fire; it ignites the coal, which in its turn communicates fire to the saltpetre.

It is to be remembered that carbonization referred to by M. Violette was effected in closed retorts, by means of dry heated steam. The temperatures referred to are the centigrade.

The improvements in the manufacture of powder, introduced at Esquerdes, in France, under the direction of M. Violette, and which have given to the products of this manufactory a reputation exceeding that of any other, depend on a new method of preparing the charcoal, which is obtained by calcination of the wood by means of a current of overheated steam. This charcoal, called *carbon roux*, has but one objection—its price. To overcome this difficulty, M. Gossart has devised a method of executing this process by heating with gas, which saves about 80 per cent. of the cost of the process for heating the steam.

It is apparent that this method is not only applicable to steam and to carbonization, but may be employed with advantage whenever a fluid is to be heated. But the author has had in view *specially* the making of red charcoal, (*carbon roux*,) and on this point it has been examined by the Committee of the Ordnance Department of France. The following is an extract from the report of this Committee to the Minister of War:—

"With the apparatus proposed 100 kilogrammes of wood may be carbonized at once. The following is the method: The water for evaporation is injected through a pump whose piston is charged with a weight little above the force of tension desired for the vapor. The pressure causes the water to rise through a graduated orifice, in a series of tubes arranged like a ladder, and enclosed in tubes of larger bore. These last convey the gas, and also serve for the condensation of the steam after it leaves the carbonizing apparatus. The circulation goes on from above downwards. By this arrangement the cold water of the tubes will absorb the greater part of the heat of the gas and of the condensed water, thus heating itself more and more in its upward movement; it finally reaches the temperature of ebullition, and is in part turned into steam in a serpentine with parallel tubes arranged so as to cover the top and sides of the furnace. The water vaporizes in these tubes, and is overheated in its passage across the metal

turnings or granulated metal with which they are filled. The steam thus overheated is conducted into a reservoir of cast iron, furnished with a thermometer and manometer indicating its heat and tension; then it passes to the carbonizing apparatus. To pass out of this apparatus, the steam and gas are conducted in the enveloping tubes mentioned above; the condensed water and the gas, now nearly cold, pass out, to be rejected by an arrangement for this purpose at the lower part of the apparatus. The air for promoting the combustion is heated by passing along a portion of the walls of the chimney and the vent holes before arriving under the grating, by which means heat is economized. The following are the advantages of the method:—

1. Only one fire is used for producing the overheated steam; and a single fireman suffices.
2. Only the amount of water actually necessary for producing the steam is heated, and just as it is required.
3. The greater part of the heat is utilized, which was before carried off by the steam and gas and totally lost.
4. The use of metallic furnaces renders it easy to multiply the heating surfaces, and at little cost.
5. The heating is regular, the temperature very equal, and the products obtained are uniform.
6. The best heating effects are obtained by the arrangement for bringing the hot air under the grating.

The Committee hence recommend an appropriation to enable the powder establishment of Esquerdes to make these arrangements. The appropriations have accordingly been authorized."

GIGANTIC CLAY MODELS.

Among the novelties of the new English Crystal Palace, are clay models of various forms of extinct animals, constructed of the natural size, and perfect in all their anatomical details and in the characteristic features peculiar to the living animals. Some of these models contain thirty tons of clay, which have to be supported on four legs, as their natural history characteristics would not allow of recourse being had to any of the expedients for support allowed to sculptors in ordinary cases. In the instance of the Iguanodon, this was no less than building a house upon four columns, as the quantities of material of which the standing Iguanodon is composed consist of four iron columns nine feet long by seven inches in diameter, 600 bricks, 650 five-inch half-round drain tiles, 900 plain tiles, 38 casks of cement, and 90 casks of broken stone, making a total of 640 bushels of artificial stone. This, with 100 feet of iron hooping, and 20 feet of cube inch bar, constituted the bones, sinews, and muscles of this large model, the largest of which there was any record of a casting having been made.

NOVEL CHIMNEY CONSTRUCTION.

The Boston Gas Company have recently erected a chimney upon a somewhat novel plan. The chimney has two levels, and is 170 feet high from the lower one. It is well known that the draught depends mainly on the warmth of the flue. At the base, of course, in ordinary chimneys, the air is warm, and the smoke ascends lightly, but on reaching a considerable height the air becomes cold and the draught ceases. To improve the draught, this principle is employed. The chimney is circular, and is incased by a square structure, which rises from the base to the top of the chimney; this case or exterior wall is hollow, filled with air, and hermetically sealed, and, according to a well-known philosophical principle, becomes filled with hot air; this air space of course keeps the flue warm. The chimney will probably cost about $5,000.

MANUFACTORY OF BEET ROOT SUGAR IN FRANCE.

The quantity of sugar made from beet root, to the end of the fourth month of the season, February, 1854, was 73,987,419 kilogrammes, being very nearly equal to the entire season of September, 1852, to September, 1853. No branch of commerce in France has been so successful as the fabrication of sugar from beet root. The original discovery of the process was due to M. Thiery, a common clerk in the office of the prefect of Lille, and who shortly after became director of the first beet root sugar factory erected in France at Passy, and who, as a reward for his valuable invention, received from the Minister of the Interior, in the year 1810, the sum of three hundred francs.—*Brussels Herald.*

Schuetzembach, a French manufacturer, well known by his improvements in the beet sugar manufacture, has lately made a very important improvement in this branch of industry, which is spoken of with enthusiasm by the French papers, as insuring great economy in the manufacture of sugar. The improvement consists in a new mode of lixivating or washing the pulp instead of pressing it by means of hydraulic presses—an apparatus large enough to work 100,000 to 120,000 pounds of beet-pulp in twenty-four hours can be constructed and put up for $1,200; the same quantity of pulp would require six hydraulic presses, costing $5,000. The cost of keeping these presses in repair averages about 20 per cent., whereas in the new apparatus the repairs will amount to about five per cent. To work six hydraulic presses requires six-horse power; the new plan requires but two. This improvement affords not only great economy in the first establishment of a sugar manufactory, in keeping it in order, in horse power and manual labor, but it enables the manufacturer to extract 20 per cent. more sugar from the same quantity of pulp than by the old process.

SOAP AS A MEANS OF ART.

Dr. Ferguson Branson, of Sheffield, writing in the *Journal of the Society of Arts*, says: "Several years ago, I was endeavoring to find an easy substitute for wood engraving, or rather to find out a substance more readily cut than wood, and yet sufficiently firm to allow of a cast being taken from the surface when the design was finished, to be reproduced in type-metal, or by the electrotype process. After trying various substances, I at last hit upon one which, at first, promised success, viz.: the very common substance called soap; but I found that much more skill than I possessed was required to cut the fine lines for surface printing. A very little experience with the material convinced me, that, though it might not supply the place of wood for surface printing, it contained within itself the capability of being extensively applied to various useful and artistic processes in a manner hitherto unknown. Dye-sinking is a tedious process, and no method of dye-sinking that I am aware of admits of freedom of handling. A drawing may be executed with a hard point, on a smooth piece of soap, almost as readily, as freely, and in as short a time as an ordinary drawing with a lead pencil. Every touch thus produced is clear, sharp, and well defined. When the drawing is finished, a cast may be taken from the surface in plaster, or, better still, by pressing the soap firmly into heated gutta percha. In gutta percha, several impressions may be taken without injuring the soap, so as to admit of 'proofs' being taken and corrections made—a very valuable and practical good quality in soap. It will even bear being pressed into melted sealing-wax without injury. I have never tried a sulphur mould, but I imagine an impression from the soap could easily be taken by that method." Dr. Branson has also employed beeswax, white wax, sealing wax, lacs, as well as other plastic bodies; and in some of these cases, a heated steel knitting needle, or point, was substituted for the ivory knitting needle. He has sent several specimens to the Society of Arts, which show that, from the gutta percha or plastic cast, a cast in brass may be obtained, with the impression either sunk or in relief.

THE NEW PROCESS OF PRINTING FROM NATURE.

The Director of the Imperial Printing Office of Vienna has invented, and brought into successful working, a means of producing embossed facsimiles of objects, which it is attempted to make subservient to the purposes of natural history illustration. Substantially the same invention has also been made and patented in England, (See Annual Scientific Discovery, 1854, pp. 95–97,) and introduced into practical working, by Bradbury & Evans, of Manchester. More importance has, however, been attached to this invention than it is fairly entitled to; but, so far as regards its economy and usefulness, in such cases as the production of

pattern-books for lace manufacturers, we see no reason to doubt its success. It can never supersede the work of the draftsman in books of science. Messrs. Bradbury & Evans's folio plates would form an admirable substitute for an herbarium, if they could produce fac-similes in relief of all plants alike, with their botanical detail in its natural condition; but the objects represented have to be submitted to an amount of pressure which destroys all the parts not hard enough or flat enough to resist it, so that we have merely representations of *crushed* plants. The process is as follows: The specimen is placed on a polished steel plate, and upon this is placed a polished plate of soft lead. The plates are then passed, sandwich-like, between the cylinders of an ordinary copper-plate printing press, subject to a pressure of 800 to 1000 hundred weight, and the softer of the two metal plates, being sensitive of the faintest impression, affords a beautiful matrice for the casting of a type-plate, from which a fac-simile of the object may be printed. The embossed printing for the use of the blind suggests a resemblance. Impressions of hard subjects, such as fossil fish, have been procured by taking a cast of them in gutta percha, and submitting that to the sandwich-pressing process in place of the object. A very clever fac-simile of a crushed plant is produced, and all the detail that can resist crushing is impressed on the lead with a fidelity and promptness quite beyond the reach of manipulation; but it is obvious that only such thin and delicate subjects as sea-weeds or macerated leaves can escape destruction in the process. No sufficient detail of the flower or fruit of a plant can be produced for botanical purposes.

GLYPTOGRAPHY.

This art is the invention of Mr. John Doulevy, of New York, and its object is to produce colored impressions at a comparatively small expense, and with a precision and elegance of finish which have hitherto been unattainable by the processes of engraving or lithography. Its principal characteristic is the use of intaglio types instead of the ordinary types in relief, combined with peculiar plastic processes, by which colored plates, adapted to every variety of chromatic effect, can be printed by the operation of the common typographic press. Hitherto typography has been limited to impressions of a uniform color, without aiming at illuminated letters or pictorial embellishments. In Chromo-glyphotype, the process is directly the reverse of ordinary typography, or printing in relief. The relief types are raised above, the intaglio types are sunken into, the surface of the plates. The impression produced from relief type is taken from the letter, leaving it without back-ground. The impression produced from intaglio type is taken from the entire surface of the block in which the letter is engraved, presenting the letter in the midst of a back-ground, either plain, or with any variety of ornament, as may be desired. Thus is given a uniform, unbroken, equally-tinted surface, in which the letters appear as if they were etched upon a copper plate, sunk into the body of a wood

engraving, or drawn upon a colored lithographic stone—the only difference being the accuracy and beauty of the impression. But this is not all. The method just described is connected with another invention, based on the typographic principle of combination and distribution, but in which an alphabet of artistic forms is combined and distributed instead of letters.

THERMOGRAPHY.

This is the designation bestowed by M. Felix Abate on a method lately discovered by him for transferring figures and tracings, whether natural or artificial, to wood, calico and paper, directly from the objects themselves, provided these possess, or are capable of being converted into, plane surfaces. This invention is an offshoot of the mode employed in Birmingham and Sheffield for transferring raised patterns, such as lace to metal, by means of pressure; but instead of this transfer of the figure from the natural object, say a feather, to the soft metal, thence to an electro-copper plate, and at last to the paper, M. Abate proposes to print directly from the objects themselves, and has exhibited to the Society of Arts some imitations of veneer and of inlaid work taken on sheets of wood, calico and paper, and which he states were procured by the following process: The sheet of veneer or inlaying to be copied is to be exposed for a few minutes to the vapor of hydrochloric acid. The inventor names also sulphuric acid vapors; but this must be a mistake, this acid not emitting fumes at common temperatures; or it is to be damped with either of these acids diluted, and the excess of moisture carefully wiped off. The sheet of veneer is then laid upon one of calico or paper, and an impression struck off by a common printing-press; this impression remains invisible until, as with many of the sympathetic inks, it is exposed to the action of heat, which is to be applied immediately after the sheet is printed off, when a perfect impression of all the marks, figures, and convoluted lines of the veneer is instantaneously produced. This may be repeated for an almost indefinite number of times, wetting the veneer occasionally with the dilute acid, without the impression growing fainter. The designs thus produced all exhibit a general wood-like tint, most natural when oak, walnut, maple, and the light-colored woods have been employed; the darker woods, as mahogany, rosewood, &c., may be printed on cloth or paper, dyed or stained to a light shade of the ground color of the particular wood.

These impressions show an inversion of tints in reference to the original wood—the light parts being dark, and *vice versa;* but this does not interfere with the general effect. Should, however, a true image be desired, the inventor damps the wood-surface with a solution of ammonia, and then prints on the cloth or paper previously wetted with the dilute acid, and exposes to strong heat as before, when, he states, the effect will be a true representation of the wood.

This process will undoubtedly prove useful in decoration, since it

obviously affords us the means of multiplying, at very little cost, accurate copies of rare and costly woods, marquetrie, mosaic, and inlaid work generally, the which may be used for paper hangings, as wainscoting and panelling; or, if well varnished with hard varnish, serve for many descriptions of "occasional furniture," toys, and boxes of various kinds, for which purpose choice veneers are now employed; thus furnishing a great variety of cheap and tasteful things at a cost within the reach of people of limited means.

M. Abate also describes another process he calls *metallography*, or printing on metallic surfaces from engraved wood blocks. In this process the block is damped with a solution of such salts as are decomposed by contact with certain salts; as, for instance, the salts of copper, antimony, &c., applied to the block and printed on zinc and tin; or of hydro-sulphuret of ammonia, on copper, brass and silver; salts which deposit either an adherent metallic pellicle, a film of colored metallic oxide, or stain the metal by the formation of a sulphuret; thus producing the figure cut on the block as in ordinary printing.

Galvano-plastic Niello.—Niello, a peculiar style of enamelling, consists in engraving or stamping figures on a plate of silver or gold, and then filling the incised lines, or impressed pattern, with a sort of enamel, differing, however, from true enamel, which is a kind of glass, by being formed of a mixture of the sulphurets of lead, silver and copper. This mixture is of a black color—hence the name niello, from nigellum, derived from niger, black—and when melted into the intaglio parts of a plate, gives it somewhat the appearance of an inked engraved copper plate. A new kind of niello work has lately been introduced on the Continent, in which, however, the figures are not produced by an enamel of sulphuret of silver, as in the true niello, but by a different colored metal: thus on a plate of gold may be produced fine engravings, the lines of which are in silver, and so on. * * * Many highly ornamental and useful applications might be made of these processes, especially in the manufacture of church furniture. Instead of simply engraving the name and legend upon pieces of plate presented to persons, it might be put in letters of gold at very little more expense.—*Mining Journal.*

GREAT ORGAN AT LIVERPOOL.

The following particulars of interest are published concerning the monster organ recently placed in the Town Hall of Liverpool, by Mr. Willis:—

The instrument consists of four rows of keys, from G to A, *i.e.* GG to A in altissimo, 63 notes; and two octaves and a half of pedals, from C to F, *i.e.* CCC to F, 30 notes. There are 108 stops and 8,000 pipes, varying in length from 32 feet to three-eighths of an inch, ten octaves apart. The grand source of wind is from two immense bellows, each having three feeders, placed in the vaults below the floor of the hall. These are blown

by a steam-engine, consisting of a pair of oscillating cylinders. There are besides twelve other bellows, or reservoirs, each giving its own appropriate pressure of air to those stops or pipes which it supplies. The pneumatic lever is applied to each of the manuals distinctly, and also distinctly or separately to the manual couplers. To the pedal organ there is a double set of penumatic levers; but the most elaborate use of this power is found in its application to the combination of stops; here we have it exhibited in a compound form to each organ individually, and to the whole collectively, where by one operation the player is enabled to produce a combination of stops upon the entire instrument at once. This movement appears in a series of six handsome gold-gilt knobs, placed immediately under each set of manuals, at about two keys' distance from each other, occupying a central position, always within reach of one or other of the performer's thumbs. The pneumatic lever is also applied to the opening and shutting of the swell louvres and some other less important purposes.

ON THE COLLECTION AND VALUE OF STATISTICAL INFORMATION.

The Earl of Harrowby, President of the British Association, in his annual address, thus adverts to the labors of the statistical section of that body; his remarks apply to all societies of like character, and especially controvert the position of those who regard the accumulation of such information as of little or no value:—

"Who shall separate political altogether from the influences of physical geography, or ethnology from physiology, or the destinies of man upon this globe from the study of his physical nature? By its employment of the doctrine of probabilities, one branch of statistics is brought into immediate contact with the higher mathematics, and the actuary is thus enabled to extract certainty in the gross out of uncertainty in the detail, and to provide man with the means of securing himself against some of the worst contingencies to which his life and property are exposed. In fact, statistics themselves are the introduction of the principle of induction into the investigation of the affairs of human life—an operation which requires the exercise of at least the same philosophical qualities as other sciences. It is not enough, in any case, merely to collect facts and reduce them into a tabular form. They must be analyzed as well as compared; the accompanying circumstances must be studied, (which is more difficult in moral than in material investigations,) that we may be sure that we are (that is to say, in reality calling the same things by the same names) treating of the same facts under the same circumstances; and all disturbing influences must be carefully eliminated before any such pure experiment can be got at as can fairly be considered to have established a satisfactory conclusion. In some cases this is easier than in others. In regard to the probabilities of life or health, for instance, there are, at least, no passions or prejudices, no private interests at work, to interfere with the faithful accumulation of

the facts ; and if they be numerous enough, it might be supposed that their number would be a sufficient protection against the effect of any partial disturbances. But even here, caution, and special as well as extensive knowledge, are required. There are disturbing influences even here —habits of life, nature of employment, immigration or emigration, ignorance or mis-statement of age, local epidemics, &c., which leave sources of error in even the most extended investigations. Still results are attained, errors are more and more carefully watched against, and allowed for, or excluded, and more and more of certainty is gradually introduced. And here I should not omit to notice the valuable services of the Society of Actuaries. They discuss all questions to which the science of probability can be applied, and that circle is constantly extending ; assurance in all its branches, annuities, reversionary interests, the laws of population, mortality, and sickness ; they publish transactions, and, what is of the greatest importance in this, as indeed of any branch of inductive science, they hold an extensive correspondence with foreign countries. In fact, they are doing for the contingencies of human life, and for materials apparently as uncertain, something like what meteorology is doing for the winds and waves.

What shall I say of the statistics of crime, of education, of pauperism, of charity, at once and reciprocally the effect and the cause of that increasing attention to the condition of the people which so favorably distinguishes the present age? Who can look at the mere surface of society, transparently betraying the abysses which yawn beneath, and not desire to know something of its secrets, to throw in the moral drag, and to bring to the light of day some of the phenomena, the monstrous forms of misery and vice, which it holds within its dark recesses. And who can look at these things, no longer matter of conjecture, but ascertained, classed, and tabled, without having the desire awakened or strengthened to do something towards remedying the evils thus revealed, and without feeling himself guided and assisted towards a remedy? Yet here, more than in other cases, should a man suspect himself; here should he guard himself against hasty conclusions, drawn from the first appearance of the results; for here are disturbing influences most busily at work, not only from without, but from within ; not only in the nature of the facts themselves, but in the feelings, passions, prejudices, habits, and moral constitution of the observer.

Still, the tabling of the facts is of infinite importance. If they disturb, as they are sure to do, some feeling, some prejudice, some theory, some conviction, it will be felt that, any how the facts have to be accounted for, further investigation will follow ; and if it appear that no correction is required, the truth will be established, and the hostile theory will, sooner or later, give way and disappear. In these things it is, of course, more than usually important that the facts to be selected for collection should be such as are, in their own nature and under the circumstances, likely to be ascertained correctly, and that the business of collection should be in

the hands of those who have no bias to do it otherwise than fairly, no interest in the result.

Nor can I, while speaking of statistics, avoid referring to the Statistical Congress which took place at Brussels about this time last year; which had mainly for its object, to produce uniformity among different nations, in the selection of the facts which they should record, and in the manner of recording them; without which, indeed, no satisfactory comparisons can be established, no results can safely be deduced. To bring about such a uniformity absolutely, is, I am afraid, hopeless; inasmuch as the grounds of difference are, in many cases, so deeply embedded in the laws, the institutions, and the habits of the different countries, that no hammer of the statist is likely to remove them.

To understand, however, the points of difference, even if they are not removed, is, in itself, one great step towards the object. It at least prevents false conclusions, if it does not fully provide the means of establishing the true ones. It gets rid of sources of error, even if it fails of giving the full means of ascertaining truth. Take, for instance, the case of criminal statistics. We wish to ascertain the comparative prevalence of different crimes, either at different times or in different countries. For this purpose, must we not know under what heads the jurists and statists of the times or countries to be compared array the various offences which are recorded; with what amounts of penalty they were visited; and with what rigor, from time to time, the penalties were enforced?

That which is called manslaughter in one country, and assassination in another, is called murder in a third. That which, in one country, is punished with death, in another is visited by imprisonment. The bankruptcy which, in one country, is a crime, in another is a civil offence. The juvenile offences, which in one country are punished by imprisonment, and swell the criminal calendar, in another are treated, as they should in many cases be, only as a subject of compassion and correction,—take no place in the criminal calendar at all.

Indeed, it is one of the difficulties which beset a large proportion of these investigations, whether into morals, health, education, or legislation, and which must always distinguish them from those which deal either with matter or defined abstractions, that, in using the same terms, we are often uncertain whether we mean the same thing; whether, in fact, when we are using the same denominations, the same weights and measures are really employed. Such conferences, however, as those of Brussels, tend much to limit the extent of error.

With regard to the statistics of agriculture, the main object is, to procure such a knowledge of the facts as shall guide the operations of the consumer and the merchant. I would suggest that they should be taken and published at two periods of the year, once in the spring, recording the extent of soil devoted to each kind of grain,—a fact easily ascertained; the second time as soon as the harvest is concluded,—announcing the amount of the crop, as ascertained on several specimen fields, under differ-

ent circumstances of soil and climate, and applying it, in due proportion, as a multiple to the acreage already published. A really accurate census of the harvest is, I believe, impracticable, at least within the period which would alone make it valuable for present use; and the approximation which I have suggested would, I conceive, be adequate to the purpose."

CURIOSITIES OF THE ENGLISH CENSUS.

The English census of 1851, it is well known, by a most careful and pre-arranged method, was taken over the whole kingdom, during a single day and evening, viz., that of the 30th of March. The complete returns furnish much information of a curious as well as useful character. The total population of the kingdom was found to be as follows :—

	Males.	Females.	Total.
England, . . .	8,281,734	8,640,154	16,921,888
Scotland, . . .	1,375,479	1,513,263	2,888,742
Wales, . . .	499,491	506,230	1,005,721
Islands, . . .	66,854	76,272	143,126
Army, Navy, and Merchant Service,	162,490	—	162,490
Totals, . .	10,386,048	10,735,919	21,121,967

The census illustrated this 21,000,000 of people by an allusion to the Great Exhibition. On one or two occasions 100,000 persons visited the Crystal Palace in a single day; consequently 211 days of such a living stream would represent the number of the British population. Another way of realizing 21,000,000 of people was arrived at by considering their numbers in relation to space: allowing a square yard to each person, they would cover *seven square miles*. A further illustration; if all the people of Great Britain had to pass through London in procession four abreast, and every facility was afforded for their free and uninterrupted passage for 12 hours daily, Sundays excepted, it would take nearly *three months* for the whole population of Great Britain to file through at *quick* march, *four* deep. The excess of females in Great Britain was 512,361, or as many as would have filled the Crystal Palace five times over. The proportion between the sexes was 100 males to 105 females, a remarkable fact when it was considered that the births during the last 13 years had given the reversed proportion of 105 *boys* to 100 *girls*. The annexed statement exhibits the population of Great Britain at each census from 1801 to 1851 inclusive :—

Years.	Males.	Females.	Total.
1801 . . .	5,368,703	5,548,730	10,917,433
1811 . . .	6,111,261	6,312,859	12,424,120
1821 . . .	7,096,053	7,306,590	14,402,643
1831 . . .	8,133,446	8,430,692	16,564,138
1841 . . .	9,232,418	9,581,368	18,813,786
1851 . . .	10.386,048	10,735,919	21,121,967

The increase of population in the last half century was upwards of 10,000,000, and nearly equalled the increase in all preceding ages, notwithstanding that millions had emigrated in the interval. The increase still continued, but the *rate* of increase had declined, chiefly from accelerated emigration. At the rate of increase prevailing from 1801 to 1851, the population would double itself in 52½ years.

The number of persons absent from Great Britain on the night of the 30th of March, 1851, was nearly 200,000:—viz., army, navy, and merchant service, 162,490; and British subjects resident and travelling in foreign countries, 33,775.

The number of the houseless classes, *i. e.* of persons sleeping in barns, tents, and the open air, on the night of the census, was 18,249. The following table gives the number of these classes, together with those sleeping in barges and vessels:—

Persons sleeping in	Males.	Females.	Total.
Barges, . . .	10,395	2,529	12,924
Barns, . . .	7,251	2,721	9,972
Tents or open air,	4,614	3,663	8,277
Vessels, . . .	48,895	2,853	51,748
Totals, . .	71,155	11,766	82,921

The following table gives the number of houses in Great Britain in 1851:—

	Inhabited.	Uninhabited.	Building.
England, . .	3,076,620	144,499	25,192
Scotland, . .	370,308	12,146	2,420
Wales, . . .	201,419	8,995	1,379
Islands, . .	21,845	1,095	203
Totals, . .	3,670,192	166,735	29,194

About 4 per cent. of the houses in Great Britain were unoccupied in 1851, and to every 131 houses inhabited or uninhabited there was *one* in course of erection. In England and Wales, the number of persons to a house was 5.5; in Scotland 7.8, or about the same as in London; in Edinburgh and Glasgow the numbers were respectively 20.6 and 27.5. Subjoined is a statement of the number of inhabited houses and families in Great Britain at each census, from 1801 to 1851,—also of persons to a house, excluding the islands in the British seas.

Years.	Inhabited Houses.	Families.	Persons to a House.
1801, . . .	1,870,476	2,260,802	5.6
1811, . . .	2,101,597	2,544,215	5.7
1821, . . .	2,429,630	2,941,383	5.8
1831, . . .	2,850,937	3,414,175	5.7
1841, . . .	3,446,797	(No returns.)	5.4
1851, . . .	3,648,347	4,312,388	5.7

The number of inhabited houses had nearly doubled in the last half century, and upwards of two million new families had been founded. 67,609 families, taken at hazard, were analyzed into their constituent parts, and they gave some curious results. About 5 per cent. only of the families in Great Britain consisted of husband, wife, children, and servants, generally considered the requisites of domestic felicity; while 893 families had each *ten* children at home, 317 had each *eleven*, and 64 had each *twelve*. The number of each class of institution, and the number of persons inhabiting them, are annexed :—

Class of Institution.	Number of Institutions.	No. of Persons inhabiting them.		
		Males.	Females.	Total.
Barracks, . .	174	44,833	9,100	53,933
Workhouses, . .	746	65,786	65,796	131,582
Prisons, . . .	257	24,593	6,369	30,959
Lunatic Asylums, .	149	9,753	11,251	21,004
Hospitals, . .	118	5,893	5,754	11,647
Asylums, etc., .	573	27,183	19,548	46,731
Totals, . .	2,017	178,041	117,815	295,856

Of these 295,856 persons, 260,340 were inmates, and 35,516 officers and servants. The excess of males in the prisons arose from the fact that crime was four times as prevalent among males as among females.

It was mentioned as a curious trait of gypsy feeling, that a whole tribe

struck their tents, and passed into another parish, in order to escape enumeration.

The number of cities and towns of various magnitudes in Great Britain was 815 :—viz., 580 in England and Wales, 225 in Scotland, and 10 in the Channel islands. The town and country population was equally balanced: $10\frac{1}{2}$ millions against $10\frac{1}{2}$ millions. The density in the towns was 3,337 persons to the square mile; in the country only 120. The average population of each town in England and Wales was 15,500; of each town in Scotland, 6,654. The average ground area of the English town was four and three-fifths miles.

In 1851, Great Britain contained 70 towns of 20,000 inhabitants and upwards. There was an increasing tendency of the people to concentrate themselves in masses. London extended over an area of 78,029 acres, or 122 square miles, and the number of its inhabitants, rapidly increasing, was 2,362,236 on the day of the last census. A conception of this vast mass of people might be formed by the fact, that if the metropolis was surrounded by a wall, having a north gate, a south gate, an east gate, and a west gate, and each of the four gates was of sufficient width to allow a column of persons to pass out freely *four* abreast, and a peremptory necessity required the immediate evacuation of the city, it could not be accomplished under *four-and-twenty hours*, by the expiration of which time the head of each of the four columns would have advanced a no less distance than *seventy-five miles* from their respective gates, all the people being in *close* file, *four* deep.

The 624 districts of England and Wales classed in an order of density ranged from 18 persons to the square mile in Northumberland, to 185,751 in the East London district. In all London there were 19,375 persons to the square mile. In 1801 the people of England were on an average 153 yards asunder, in 1851 only 108 yards. The mean distance between their houses in 1801 was 362 yards, in 1851 only 252 yards. In London the mean proximity in 1801 was 21 yards, in 1851 only 14 yards. The number of islands in the British group was stated at 500, but inhabitants were only found on 175 on the day of the census.

The precautions taken by government to secure extreme accuracy were very great; they involved the final process of a minute examination and totaling, at the Census Office, of 20,000,000 of entries, contained on upwards of 1,250,000 pages of the enumerators' books. The latter were upwards of 38,000 in number.

In the collection of the census, the first step taken by the enumerators was to deliver to every occupier of a house or tenement a householder's schedule. Upon this schedule inquiry was made as to the name, relation to head of family, condition, sex, age, occupation, and birthplace of every person in Great Britain, and also as to how many of them were blind, or deaf and dumb. For the use of the poorer native population of Wales, a certain number of the forms was printed in the language of that country. The total number of schedules forwarded from the census

office was 7,000,000, weighing nearly 40 tons; or, if the blank enumeration books and other forms be included, upwards of 52 tons. The schedule was to be filled up on the night named. No one present on that night was to be omitted, and no person absent was to be included, except policemen and others on night duty; and miners, potters, and other workpeople usually engaged at their labor during the night, and regularly returning home in the morning; persons travelling were enumerated at the hotels or houses at which they might stop on the following morning.

At the same time that these schedules were distributed, the enumerators delivered forms for collecting information respecting places of worship, scholastic establishments, and miscellaneous institutions, but it was optional with the respective parties to decline making these returns if they thought proper.

When a house was uninhabited, or in process of building, the enumerators made a note of such a case upon the schedule last collected, by which means the unoccupied houses, and houses in course of erection, were enumerated. The number of inhabited houses was indicated by the number of householders' schedules filled up.

Having collected all the schedules, and copied them into books prepared after a certain form, the enumerators summed the various totals in their respective districts. The totals thus obtained expressed the number of persons who were inmates of dwelling-houses on the night of the census, with the special addition of certain classes on night duty; but several classes had yet to be enumerated—viz.: the persons who, on the night named, slept or abode either in barges, boats, or other small vessels remaining stationary on canals or other navigable streams, in barns, sheds, and the like, and in tents or in the open air. The number of these in each district was estimated by the respective enumerators; the estimate, however, was not to include people in coasting or other sea-going vessels, as they would be dealt with by other means yet to be described.

The enumerators were allowed one week for the transcription of the contents of the householders' schedules into the enumeration book, and for the completion of the various summaries and estimates. The schedules and book, together with the returns relating to schools and places of worship, were then forwarded to the respective registrars, and the duties of the 38,740 enumerators terminated. The census returns were now in the hands of 3,220 registrars, or dividers of districts.

The registrars immediately commenced a careful and systematic examination and revision of the documents described, directing their attention, according to instructions, to nine specially defined points in respect to them. They then prepared a summary of the statements of the enumerators in their respective districts, and transmitted them, together with the enumeration books, to the superintendent-registrar, for a further revision by that officer, forwarding the householders' schedules and returns for places of worship and schools direct to the census office. With the completion of these duties, for which a fortnight was allowed, the

functions of the 3,220 registrars, or dividers of districts, ceased. The summaries and enumeration books (as far as England and Wales were concerned) were now in the hands of 624 superintendent-registrars.

The chief duties of the superintendent-registrars were to expedite the investigation, but they had also further to revise the summaries and enumeration books, and to transmit them to the census office, there to undergo a still further revision before the commencement of the abstracts.

CURIOSITIES OF THE AMERICAN CENSUS.

From the statistics collected under the seventh census of the United States, the following interesting facts have been deduced :—

1. *Law of Growth.*—This has been so uniform that the general ratio is a well-known fact; but the *mode* in which that growth has been made is very little known. Many persons have given too much weight to immigration, and others have supposed the increase of the African race more rapid than it is. Mr. Darby, in his "*View of the United States*," gave the law of population to the year 1940, which, although published twenty years ago, gave the population of 1850 but a million and a half beyond what it is; and the whole error was in the estimate of the African race, which he made 5,700,000, when it is really but 3,636,000. There has been a tendency at all times to exaggerate the increase and importance of the African as well as the immigrant population. Neither of them can ever occupy any thing but a subordinate position in a nation whose whole genius and institutions are so completely Anglo-American. This fact the census demonstrates.

The number of inhabitants prior to the Revolution cannot be obtained with accuracy; but since 1780 we have it with great exactness. Taking the decimal periods, we ascertain a very uniform law of progression, thus:

In 1790	3,929,827	
In 1800	5,305,925	—Increase 35 per cent.
In 1810	7,239,814	—Increase 36 per cent.
In 1820	9,638,131	—Increase 33 per cent.
In 1830	12,866,920	—Increase 33½ per cent.
In 1840	17,062,566	—Increase 32½ per cent.
In 1850	23,191,876	—Increase 36 per cent.

The *law* of growth has, for sixty years, been but slightly variant from 34 per cent. This is so fixed and certain that, allowing for a very little diminution of ratio, we may assume 33 and one-third per cent. (or *one-third* the existent population) as the decimal increase of growth for the next half century. We may predict, with almost certainty, that in 1910 (sixty years) the American Republic will have *one hundred and twenty millions of people*—an empire which, when its vigor, resources, and institutions are considered, will in power exceed any thing which exists, or has existed, among nations.

2. *The Law of Numerical Relation between the Sexes.*—There is a natural law of relations between the sexes, which is found to vary at different ages, according to the different dangers to which they are exposed. This is one of the most curious of the natural laws, and one of the most interesting—demonstrating the admirable economy of *adaptations* between the several parts of the natural system. If the number of males and females born was exactly equal, the result would be, that, before they reached middle age, the female sex would be reduced too low, and become inadequate to the purposes which it has to fill. In fact, the number of males born is always greater than the females by about four per cent. To illustrate the changes in the numerical relations perfectly, take the following example from the last two censuses:—

In 1840, under five years of age . . .	1,270,750 males.
In 1840, under five years of age . . .	1,203,349 females.
Excess ($5\frac{1}{2}$ per cent.)	67,441 males.
In 1850, under five years of age . . .	1,472,052 males.
In 1850, under six years of age . . .	1,424,325 females.
Excess (4 per cent.)	47,727 males.

Now, let us pass on to the age of puberty, and see what a change has taken place:—

In 1850, from 15 to 20 years	1,087,600 females.
In 1850, from 15 to 20 years	1,041,116 males.
Excess (4 per cent.)	46,484 females.

The females have now passed the males; but let us go on and see what influence motherhood has had on females:—

In 1850, from 30 to 40 years	1,288,682 males.
In 1850, from 30 to 40 years	1,128,257 females.
Excess (14 per cent.)	160,425 males.

At 70 years of age, the females are again in advance, and the same fact is developed in each census. Above we see an immense change in this relation. From birth to 20 years, the loss of males to females by death was nearly 2 to 1; but from 20 to 40, the death of females was much the greatest—so that the males are again the most numerous. Past 40, the deaths of females are the smallest. The numerical law of the sexes, then, is this:—

1. There are more males than females born by about 4 per cent.

2. At 20 years of age, this preponderance is entirely lost, and there are more females than males.

3. At 40 years, the balance is again the other way, and there are more males than females.

4. At 70, the sexes are about even, and the ultimate age of the human being is reached without any decided advantage to either sex.

Both the censuses of 1840 and 1850 prove the law. Between 70 and 100 years of age, there are 15,311 more white women than there are males; being more than 5 per cent. of the whole number. Beyond the age of 40 years, the probabilities of longevity are much greater, for American women, than that of men. This contrasts singularly with the fact that the *physique* (relatively) of American women is inferior to that of American men. That fact, as I have shown, however, tells tremendously on women between the ages of 20 and 40, when their mortality is very great.

The longevity of some women is very extraordinary. There are four hundred and thirty American women *above one hundred years of age!*

3. *The Growth of the White Race.*—The law of growth in the *races* is something different. The ratio of increase, at each successive decennial period, has been respectively—36—37—35—35—35—38 per cent. This gives us a decennial growth of about 36 per cent. for the *white race.* The growth of the white race is, therefore, decennially, about 2 per cent. greater than the growth of the whole; consequently, leaving a diminution, to a corresponding extent, in that of the colored population.

4. *The Growth of the African Race.*—The colored race have advanced, decennially, very nearly as 37—32—30—29—25—27 per cent. The parallel between the growth of the White and African races, for the last 40 years, has been thus:—

	White.	Colored.		White.	Colored.
1810 to 1820........	35	30	1830 to 1840........	38	25
1820 to 1830........	35	29	1840 to 1850........	38	27

5. *The Law of Relation in the Growth of the Races.*—As seen in the preceding paragraph, the growth of the white race exceeds that of the colored race, by nearly 10 per cent., in the corresponding ratios. But, we must remark, it seems that the *conditions* of their growth *are not parallel.* The white race is continually receiving accessions from Europe. In the last 10 years, (1840 to 1850,) the United States received about 1,500,000 white immigrants. Of these, about 600,000 died in the 10 years; so that 900,000 of the nearly 20,000,000 of white population were immigrants thus added to the national increase. The actual increase of whites was about 5,000,000; from which, deducting 900,000 immigrants, leaves 4,100,000 for the natural increase, which is about 28 1-8 per cent. In the same time, the growth of the African race was 27 per cent.; so that, in fact, there is very little difference between the ratios of natural increase in the two races, although there is some difference, and that in favor of the whites.

6. *The General Law of Increase,* (independent of immigration,) by natural causes alone, is 28 per cent. decennially. This is 8 per cent. below the average increase of the whites, and 10 per cent. below that from 1840 to 1850. While the number of born foreigners in the United States is less than 9 per cent., the number in the comparative increase of a single year is large—rising, in the last two or three years, to about half the whole increase. The original immigrants, however, rapidly die, while their children are born on the soil.

NATURAL PHILOSOPHY.

ELECTRICAL DISCOVERIES.

Signor Palmieri, of Naples, has invented a movable conductor—a disk of wood, bearing metallic points, rotating on an axis, which enables him to correct the errors of former observers of electrical phenomena. The idea of negative rains or clouds, he says, must be given up, because the differences observed are due only to time: for instance, the atmosphere will be negative when a shower is approaching, positive while the rain is actually falling, and negative again as it passes away. He hopes, by means of his new instrument, to arrive at some of the laws which govern the fall of rain in European latitudes. A curious fact has been noticed also with respect to gutta-percha, which may be interesting to electricians. This substance, as is well known, acquires a bluish tinge after having been kept some months; and when in this state, it can no longer be negatively electrified, as before, by almost any substance with which it may be rubbed. Its electricity is found to be positive; and the only substances which will electrify it negatively are mica, diamond, and fur.

M. Palagi, of Bologna, and M. Volpicelli, of Rome, sustain the opinion that the change of distance between two bodies constitutes them in different electrical states, as they are removed from or advanced to each other. M. Volpicelli, while endeavoring to frame the experiment which shall exhibit this phenomenon, has discovered a singular electro-static property. When an insulating stick of glass, or sealing-wax, or sulphur, is placed on an insulated or non-insulated support, (*e. g.*, sliding through one or several rings,) the natural electricity of the stick is distributed by the rubbing, which rises from the motion in a singular way; the electricity accumulates in one of the extremities of the stick, at the same time diminishing in the other, so that there is a point between the two extremities in the normal state. If the stick is of glass, the extremity which is on the side towards which the motion is operated presents positive electricity, and the other extremity negative electricity; the contrary takes place if the stick is of wax or of sulphur. The new electro-static polarity manifests itself in the extremities, even when the rubbing takes place only on a very small part in the midst of the insulating stick, and when the extremities themselves have no share in the rubbing.

ON TRANSMISSION OF ELECTRICITY.

Prof. Farraday has recently completed some experiments on the first effects of a current admitted into an insulated conductor, and to ascertain the causes of the excessive differences which exist between the several ascertained velocities of electricity. It is a fact, that in Mr. Wheatstone's apparatus it travels at the rate of 100,000 leagues a second, while in the wire connecting London and Brussels, Mr. Airy found it required more than that time to traverse a thousand leagues. As the company for the manufacture of submarine telegraph wires placed their wires at Mr. Farraday's disposal, he had an excellent opportunity to pursue his researches. The mode adopted by Mr. Statham, (the superintendent of the company,) to ascertain the degree of insulation the gutta percha coated wires possess, is to lay them along large floating frames, in such a way that they shall be completely submerged, with the exception of their two ends, which are kept in the air; two hundred of these wires are submerged together; their total length is forty leagues, when they are connected together by their extremities, (which is very easily done.) A battery of 30 pair, connected with the earth by one of its poles, while the other communicates by means of a galvanometer with the submerged wire, is the test employed; if the gutta percha coating is not perfect, there is a loss of electricity, which is indicated by the galvanometer. I may premise, the submerged wires may be taken out of the water and suspended in the air at the will of the experimenter. Mr. Farraday found the wires, when submerged, acted precisely as though they were a Leyden jar, the wire playing the part of the tin foil coating, the gutta percha the part of the glass, and the water the part of the exterior tin foil coating; as one electricity was engaged in the submerged wire, its major part was dissimulated by the contrary electricity, which, flowing from the earth, fixed itself in the water in contact with the gutta percha coating, where it accumulated until the tension became so great that the apparatus refused to receive further charges, notwithstanding the play of reciprocal influences. In this state of things all communication established between the wire and the earth reunites the two coatings as an exciter; but as some time was required to charge the wires, the discharge likewise requires a corresponding time. In the air, of course, (for the water is wanting,) the wire becomes incapable of taking sensible charges. These negative and positive results furnish a striking proof of the identity of static electricity, furnished by the machine, and dynamic electricity, furnished by the battery. This delay the constitution of the submarine telegraph superinduces in the propagation of a current allowed Mr. Farraday to easily make a very beautiful experiment: he sent electrical waves in the wires; he even sent several, one after the other; and they did not confound themselves together. But these waves have a tendency to diffuse themselves as they advance; for if, after having established the contact between the battery and the end of the wire, the experi-

menter places the latter in communication with the ground, new phenomena appear. A portion of the electricity which had penetrated in the wire returns, giving a retrograde current; and if the head of the wave has had time to reach the other extremity of the line, it gives rise to a contrary current, so that the wire pours out its electricity at both ends, by two inverse currents! All of these phenomena disappear when the wires are suspended in the air. Mr. Farraday holds, that the velocity of electricity is not absolute, and that it varies with its source: "it varies with the tension of its first urging source."

ELECTRIC ILLUMINATION.

There have been recently some attempts made at Paris towards illuminating the bottom beneath water. At the Lake d'Enghien, M. Duboscq, the successor of Soleil, performed an experiment of this kind before many competent observers. The electrodes of carbon were placed in a glass globe, being connected with one of Duboscq's regulators, which communicated with the battery by means of a copper wire covered with gutta-percha. The globe, submerged to a depth of five meters, spread light over a circumference of about ten meters radius, and it remained constant for about ten hours, after which the carbon required replacing. The idea of this process was suggested to Duboscq by an agent of a company engaged in exploring the bottom of the Mediterranean where the battle of Navarino took place. The diver usually remained beneath the water three-quarters of an hour, after which he came up to breathe and rest; his light was an oil lamp, placed on the head of the diver, and fed with air proceeding from his respiration, whence it was in a variable current, and was often extinguished, requiring him to go up and re-light. Duboscq's arrangement was devised to avoid these inconveniences. It is light, so that the diver may carry it in his hand, and at the same time it is strong and well secured hermetically, to resist a pressure of fifty or sixty meters of sea water. It consists of a cylinder of strong glass secured to a brass foot, and surrounded with a gutta-percha sac. The light passes out through a large plano-convex lens, the convexity inward, the focus being so arranged that the rays escapen early parallel. As the lamp is movable, the diver walks about with it, and places it where he wishes to make any search; and as it is only necessary to bring the electrodes near one another to light it, the diver need only turn a small screw to continue the light ten hours, which is more than twice as long as he can remain at the bottom.

To illumine the bottom at small depths, Deleuil uses a Fresnel lens, and this is daily in operation in a bathing establishment constructed on the Seine in Paris. The regulator, and also the light, are ten meters above the surface of the water, and the light penetrates sufficiently far to enable us to see the swimmer at a depth of from two to three meters, and follow all his movements.

LIGHTING BY ELECTRICITY.

During the past summer, in the prosecution of some public works at Paris, it was thought expedient to urge the work by night, as well as day, and the aid of the electric light was resorted to with great success. M. Regnault, who took charge of the lighting, communicates to the Comptes Rendus the following statement of the expense. The apparatuses, which worked regularly with great success for four consecutive months, were composed each of a battery of fifty Bunsen elements of large size.

The expense per day was as follows:—

Wages of the workmen,	4.50	francs.
Mercury,	5.00	"
Zinc,	4.50	"
Charcoal points,	1.50	"
Nitric acid,	1.80	"
Sulphuric acid,	1.84	"
Totals,	19.04—$3.80	

Two sets of apparatus being employed, the expense of lighting 400 workmen was then 38.08 francs—$7.62, per evening, or 1.9 cents per man. The economy is considerable, and the work can be done without danger, and with a regularity which cannot be obtained by any other means.

ON THE ARRANGEMENT OF LIGHTNING CONDUCTORS.

At the British Association, Mr. Nasmyth described a Lightning Conductor for Chimneys, which he conceived affords more perfect insulation, and is therefore safer, than those in common use. The present practice is to fix the conductor outside the chimney by metal holdfasts, by which means during severe thunder-storms chimneys are often damaged by the lightning entering at the points of attachment and displacing the bricks. In the method of fixing the conductor recommended by Mr. Nasmyth, the metal rod is suspended in the middle of the chimney by branching supports fixed on the top. A conductor of this kind had proved efficient in storms which had severely injured other chimneys in the neighborhood that were protected in the usual manner. An experience of eighteen years had tested the superiority of the plan.

Prof. Farraday, on being called on for his opinion, said that he recommended that lightning conductors should be placed inside instead of outside of all buildings. He had been consulted on that point when the lightning conductor was fixed to the Duke of York's Pillar, and he advised the placing it inside; but his advice was not taken, and the rod was fixed outside, to the great disfigurement of the column. All attachments of metal to or near the conductor are bad, unless there be a continuous line of conduction to the ground. He mentioned the instance of damage

done to a light-house in consequence of part of the discharge of lightning having passed from the conductor to the lead fastenings of the stones. The practical question for consideration was, how far they could safely run lead between the stones of such a structure; for if it were done partially, leaving a discontinuous series of such metallic fastenings, there would be great danger of the stones being displaced by the electric discharge. When such fastenings are used, care should be taken that they are connected together and with the earth by a continuous metallic conductor. Some persons conceived that it is desirable to insulate the conductor from the wall of a building by glass; but all such contrivances are absurd, since the distance to which the metal could be removed from the wall by the interposed insulator was altogether insignificant compared with the distance through which the lightning must pass in a discharge from the clouds to the earth. On being asked whether a flat strip of copper was not better than a copper rod, Professor Farraday said that the shape of the conductor is immaterial, provided the substance and quality of the metal are the same.

NOTICE OF SOME EXPERIMENTAL RESEARCHES INTO THE APPLICATION OF THE VOLTAIC BATTERY TO THE IGNITION OF GUNPOWDER.

Capt. Ward having been requested by Sir John Burgoyne, Inspector-General of Fortifications, to carry out some experiments for determining the best form of voltaic battery for military purposes, he made himself fully acquainted with the labors of Ohm, Wheatstone and others, and, whilst verifying many of their theoretical researches, made them the bases for his own inquiries. After a most careful comparison of several batteries, he adopted a Grove's Battery—the solid elements being zinc and platinum, and the liquid nitric acid and dilute sulphuric acid; and he finally ascertained that plates, only two inches square, were, perhaps, the most satisfactory as regards work and cost. These he arranges in small elementary batteries of six pairs, which, with the containing box, occupy a space of only seven inches long, four inches wide, and four inches deep, so that eight or nine of these elementary batteries, capable of igniting gunpowder at the greatest distances likely to be required for military purposes, would be arranged in a space of 1′ 2″ by 1′ 4″, or 1′ 9′ by 1′ 4″. In carrying out his experiments, and especially in determining the relative value of each form of battery, and the effect of any modification of the battery or of the conducting wires in respect to the calorific effect, Capt. Ward found that the deflection of the needle of the ordinay galvanometers was so great as to render it unfit for the estimation of differences in the electro-metric force in such powerful currents; and he, therefore, constructed a very simple instrument, by which he is enabled to interpose one, two, or more pieces of thin platinum wire in the circuit, and, using this instrument, in conjunction with Prof. Wheatstone's Rheostat, to determine the relative force of any battery, as well as the resistance of

the platinum wire itself, by the calorific effect exhibited on the fusion of the platinum wire. These researches are now preparing for publication in the Professional Papers of the Corps of Engineers.—*Proc. British Association.*

ON THE APPARENTLY MECHANICAL ACTION ACCOMPANYING ELECTRIC TRANSFER.

Mr. A. Crosse, in a paper before the British Association, stated that he had found that by electrifying a sovereign positively in close contact with a piece of carbonate of lime, under nitric acid diluted with fifty times its quantity of water, that a portion of the milled edge of the coin was struck off in pieces, some of which were large enough to retain the milled edge upon them distinctly. The voltaic action was kept up for fifty hours; and at the expiration of that time the coin had lost three grains in weight, and a ground glass rod that was used to keep the coin in contact with the limestone was permanently gilded; and this took place at the positive pole. The weight of the portions removed from the coin exactly corresponded with the deficiency. The solution being tested contained nitrate of lime, but no gold or copper. I likewise found on repeating this experiment with sulphuric acid, similarly diluted—the voltaic action being kept up for ninety hours—that six grains of gold were removed from the edge of the coin; and the pieces broken off weighed the same. A strip of glass being placed on the edges of the jar containing the dilute acid, and half an inch above its surface, and in a line with the electric current, had its lower part covered with crystals of sulphate of lime, each one of which was at right angles to the electric current. The friction of the carbonic acid gas liberated from that part of the limestone in contact with the coin was apparently the mechanical cause of the removal of the edges. The author stated that he had tried various experiments both with frictional and voltaic electricity upon different substances, which in his opinion proved the effects of the mechanical action accompanying electric transfer.

ON THE ORIGIN OF THE AURORA BOREALIS.

M. de la Rive, the celebrated Genevan natural philosopher, has recently published a long memoir on the Aurora Borealis, and which he has attempted to account for, and apparently with success. Perhaps no phenomenon in the world is more beautiful than "these magnetic tempests," (Von Humboldt,) which in the Arctic regions fill the heavens with a sea of flame. M. de la Rive attributes them to electro-magnetic causes. The terrestrial globe, he says, uniformly acts as a large magnet, and its magnetic poles do not coincide with its poles of rotation; furthermore, the atmosphere is continually charged with positive electricity, which is accumulated in its superior regions, and this electricity (whether

it is disengaged by the vegetation of the earth, or the continual evaporation caused by the solar heat, philosophers have not yet determined) must be expended and neutralized, or the electrical tension of the atmosphere, instead of being contained within its actual limits, would go on constantly increasing. In our latitudes, and under the equator, this discharge is effected by thunder-storms, rains, winds, and water-spouts; but these do not suffice; they are purely accidental, and Nature is obliged to resort to a more regular and constant method of operating the electrical neutralization. He supposes that the positive electricity which abounds in the superior regions of the atmosphere moves with perfect liberty in them, from their extreme rarefaction, and that it takes advantage of this facility to go to the nearest pole. Here it returns to the earth by a sort of continual, gentle flow, (*écoulement,*) which is greatly aided by the immense quantity of frozen particles floating in the air. Here, instead of returning to the ground in a single flash as we see it, through clouds of liquid particles, it reverts to the ground by gradually passing from frozen particle to frozen particle, exciting by partial discharges innumerable small aigrettes, which singly are invisible, and yet whose total seen together presents the beautiful appearance of the Aurora Borealis, and which having once reached the earth give rise to different currents, which react in turn on the magnetic needle. It may be asked why the phenomenon is concentrated around the circumference of a circle, and is prolonged in parallel columns, and is placed on the line of the magnetic axis of the globe, and why it is animated with an undulatory motion going from the West to the East, (for all these phenomena accompany the Aurora Borealis;) this question is solved by a slight change introduced into the well-known experiment of the "electrical egg," which consists in transmitting electricity from one to the other pole in a receiver from which the air has been exhausted. M. de la Rive magnetizes at will one of the two poles; when neither is magnetized, the common phenomenon takes place; but as soon as he magnetizes either of them, the light is distributed so as to form a ring, which is very much like the form of the Aurora Borealis, and like it animated by a gyratory motion. *En resumé*, M. de la Rive holds that the Aurora Borealis is owing to electrical discharges taking place in the polar regions, between the terrestrial globe and the atmosphere, by means of icy particles suspended in it there, while the charge takes place in the equatorial regions by the direct or the indirect action of the sun. These electrical discharges taking place constantly, but with varying intensity, according to the state of the atmosphere, the Aurora Borealis must be a daily phenomenon, although with differing intenseness; its visibility extends consequently to varying distances, and depends also upon the transparency of the atmosphere during the night.

VIEWS ON THE ORIGIN OF TERRESTRIAL MAGNETISM.

The following paper is communicated to *Silliman's Journal* by M. Nickles, of Paris :—

The earliest view of terrestrial magnetism supposed the existence of a magnet at the earth's centre. As this does not accord with the observations on declination, inclination and intensity, Tobias Meyer gave this fictitious magnet an eccentric position, placing it one-seventh part of the earth's radius from the centre. Hansteen imagined that there were two such magnets, different in position and intensity. Ampère set aside these unsatisfactory hypotheses by the view, derived from his discovery, that the earth itself is an electro-magnet, magnetized by an electric current circulating about it from east to west, perpendicularly to the plane of the magnetic meridian, and that the same currents give direction to the magnetic meridian, and magnetize the ores of iron; the currents being thermo-electric currents, excited by the action of the sun's heat successively on the different parts of the earth's surface as it revolves towards the east.

A long time before the discovery of electro-magnetism, Biot was occupied with this subject, and regarded the terrestrial magnetism as the principal resultant of all the magnetic particles disseminated in the earth. M. Gauss adopts this view, as an interpretation of the fact, without explaining it. An observation made some years since has directed my attention to this subject. It related to the fall of a cylindrical meteor, whose position was sensibly in the plane of the magnetic meridian. Many luminous meteors have been observed in this same position, or near it.

The special position of the meteor observed by my brother and myself was not fortuitous; it was determined by the magnetic action of the earth, an action which may be powerful in its influence on meteorites, consisting essentially of the magnetic metals, iron and nickel. In our view, the terrestrial magnet, the earth, decomposed by influence the normal fluid of the meteoric mass, and so gave the meteor thus polarized the direction of a compass-needle.

In generalizing from this fact, and recalling the experiment of Arago on the magnetism developed when a magnet acts upon a turning disk, we ask whether the magnetic polarity of our planet may not be due to a like cause. Considering it as proved, that the sun is polarized magnetically, like the earth the sun will then be the inductor magnet, the agent which decomposes the magnetic fluid of the terrestrial globe; it will be to the earth what the earth was to the meteor. This explanation does not resolve the difficulty, as it does not say whence comes the magnetic polarity of the sun. It implies the intervention of a magnet whose intensity is superior to that of the sun, acting on this last by induction, and impressing a polarity which the sun transmits to other planets of the system. It is the hypothesis reversed of the central magnet, for it places in space the

magnetic mass which some physicists have supposed to exist within the earth.

The real cause of the magnetic polarity of the planets is, in my view, the same for all, and Arago's experiment conducts to it in a straight line. It results even from the condition of their existence. Each star, turning around a central axis, and in determinate curves, is influenced by the mass of these stars and their velocity at the circumference; in a word, the agent decomposing into two fluids, the normal magnetism of the earth and the other planets is their rotation. A geometer examining this opinion, would find, we believe, that the declination, inclination, and the perturbations of the magnetic needle, are explained on this hypothesis much better than on any other.

Since my researches on circular electro-magnets, and in general on bodies in rotation, I have sought much for experimental demonstration of this theory, and have now the conviction that this is impossible, as it is not possible for us, while upon the earth, to remove ourselves from the action of its own magnetism. Whenever a development of magnetism under the influence of rotation is observed, it is common to attribute it to the inductive action of the earth, rendered so striking by the experiments of Arago and Mr. Barlow.

Alongside of the different sources of magnetism mentioned in Treatises on Physics,—friction, pressure, percussion, torsion,—we should add rotation, a mechanical action of equal title with the preceding, and whose effects, produced through a sub-division, like that of magnetic polarity, are found grouped at the extremities of the axis in rotation, in the same manner as the poles develop at the extremities of a bar of iron when it is subjected to torsion.

NEW TELEGRAPHIC BATTERY.

At a recent meeting of the Franklin Institute, Philadelphia, Dr. Turnbull exhibited a new form of telegraph battery, devised by C. T. Chester, Esq., of New York. Dr. T. remarked that this battery, while it does away entirely with local action, employs the cheapest materials and the most convenient arrangement of parts. Its cells are large, of strong glass, and they are insulated from the shelves by a partial coating of electrophorus. Its metals are amalgamated zinc, and a peculiar platinized and peculiarly insulated plate, the result of much study and experiment. The plates are supported by metal clamps and thoroughly insulated wood. The construction is such as to secure perfectly against any cross-fire. The plates can be removed and cleaned separately, without stopping the working of the battery. The solution used to excite it is a dilute sulphuric acid. How free it is from local action, may be inferred from the fact that it has been in constant use five months without being taken down, and that the zincs last such an unprecedented time. The relative cost of working the Grove, Daniell's, and the new battery, without taking

local action into consideration, supposing each equally free from local waste, is as follows, and the estimate is made up from actual experiment, by computing the destruction of battery material in each necessary to accomplish a given equal amount of work,—say the deposition of a pound of silver in the decomposition trough. Grove's, 32½ cents; Daniell's, 61; Chester's, 21.

NEW APPLICATION OF IRIDIUM.

Mr. William McRea, of Philadelphia, has recently made a valuable application of iridium, which consists in the construction of electro-receiving magnets, with their contact surfaces of iridium. The metal heretofore used for that purpose is platinum, which, although competent to resist the action of the atmosphere, fuses quickly when exposed to the electric spark from a powerful battery in a short circuit. As soon as the platinum surfaces become in a slight degree oxidized, the points adhere to each other, even when the main circuit is broken. This we may set down as one of the causes of mistakes which sometimes occur in the transmission of a message by the Morse Telegraph, the alphabet of which consists of dots, spaces and lines. It is evident, therefore, that if the points of contact of the receiving-magnet, where the main circuit of the line is broken by the transmitting operator for the purpose of making a space, be impaired, that a dot and line, or dots alone, may run together, thereby forming upon the paper a letter or character quite different from the one intended by the transmitting operator.

Iridium being the most indestructible of metals, the advantages of its application in this instance are, that the surfaces of contact will last for a much longer time without requiring any change, and will secure a more perfect and unvarying surface of contact for the passage of the current, and prevent the adhesion of the points of contact together.—*Journal Franklin Institute*, July, 1854.

IMPROVEMENT IN TELEGRAPHIC INSULATION.

An improvement of value has recently been made by Mr. Dearing, of England, in respect to the insulation of wires intended for telegraphic communication. Heretofore, in constructing electric telegraphs where the whole circuit has been made of metal, and also where the conducting property of the earth has been employed as a part of the circuit, it has been considered necessary to cause the wires to be thoroughly insulated each from the others and from the earth; the consequence of which has been, that the expense of laying down electric circuits for electric telegraphs has been very great, particularly where the same have crossed the sea, or other waters, where not only have the wires been insulated one from another, and from the water or earth, but, in order to protect the insulating matter from injury, great expense has been caused by the use

of wire rope, or other means of protection. The present patentee has discovered that a metallic circuit, formed of wires, either wholly uninsulated, or partially so, may be employed for an electric telegraph, provided that the two parts of the circuit are of such a distance apart that the electric current, or a portion of it, would meet with more resistance in passing from one wire to the other, by the water or the earth, or by imperfect conductors which the wires may be attached to or suspended from, than in following the wire. For this purpose he causes the two wires, (which may be of plain galvanized iron, either uninsulated or partially insulated by a coat of varnish or otherwise,) of which a circuit of an electric telegraph is to be formed, to be placed in the water or earth, at a distance apart proportionate to the total length of the circuit. These wires he insulates where they approach one another, to communicate with the instruments and battery or source of electricity, or with a continuation of conductors for carrying on the current, in order to prevent the current passing through the diminished space between the wires. And in the case of intermediate stations, the wires are insulated in each direction from the instruments, in order to insure the current making the circuit of the instruments, and not passing in a large proportion through the earth or water, or other conductors, between the insulated parts of the wire on each side of the station. By these means the cost of the laying down of electric telegraphs, whether submarine or otherwise, is by means of this invention, of employing distance between the conductors as a means of insulation, reduced to little more than the mere cost of the conductors for the current, together with that of an insulated wire at each end of the line to complete the circuit between the extremities of the insulated conductors; and the numerous difficulties which attend the insulation of long lengths of wire are avoided, as also the chances of the communication being interrupted by accidents to the insulation.

ON THE MAGNETISM OF ROCKS.

At a recent meeting of the French Academy, M. Regnault communicated the result of some new researches into the magnetism of rocks. He has found out that, besides being feebly attracted by the magnet, they have polar magnetism, which makes them capable of acting by attraction and repulsion on the poles of a neighboring magnet. M. Melloni attributes the tardiness of this discovery to the great weakness of the repulsive action, which renders it necessary that the experiment should be made at a very short distance from the magnetic needle, and this proximity develops in the nearest parts of the mineral attractive forces of reaction, whose intensity is greater than the repulsive action natural to the rock. To exhibit the feeble magnetism of mineral substances, he urges experimenters to use an instrument he has invented, and which he calls the magnetoscope.

VARIATION OF THE MAGNET.

Sir J. Ross stated before the Mechanical Section of the British Association, in proof of the effect of every description of light on the magnet, that, during his last voyage in the Felix, when frozen in about a hundred miles north of the magnetic pole, he concentrated the rays of the full moon on the magnetic needle, when he found it was five degrees attracted by it.

VARIATION OF THE COMPASS IN IRON SHIPS.

At the last meeting of the British Association, the Rev. Dr. Scoresby contributed a paper of great interest on the loss of the Tayleur, and the change in the action of the compasses in iron ships. Recapitulating the facts connected with the wreck of the Tayleur, which, it will be remembered, was an iron ship, the lecturer remarked that her compasses (three adapted for guidance) were all "adjusted," previous to sailing, by large and powerful magnets, on the principle suggested by the Astronomer Royal; and Mr. Grey, who had charge of the adjustment, reported that they were quite correct. On the third day of the voyage it was discovered, for the first time, that there was a material difference between the compasses. Judging from one of them placed near the helmsman, the captain was under the impression that he was sailing down almost mid-channel, or, at all events, that he was in a good position for navigating the Irish Channel; while the second showed a difference of almost two points. Not knowing which of these was correct, the captain assumed, from certain indications he had noted, that the wheel compass was accurate rather than the other. The result showed that neither was correct, and the Local Marine Board of Liverpool reported to the Board of Trade their belief that the wreck was caused by "a deviation of the compass, the cause of which they have been unable to determine." Now, he, (Dr. Scoresby,) at the meeting of the British Association at Oxford, in 1847, had called attention to the instability of the magnetic distribution in ships built of iron. So far back as 1819 he had shown that the adjustment of the compasses of iron ships by fixed permanent magnets was not only delusive, but dangerous; and he now said, referring to the case of the Tayleur, that it was an incidental (for he did not contend that it was a necessary) consequence of such an adjustment in this case that the vessel had been brought into so dangerous a position. If the compasses had not been corrected by permanent magnets, the captain would have been in a very different position for securing the safety of the ship. It was a matter well known, not only that iron became magnetic by virtue of the inductive influence of the earth, but that magnetism might be controlled, altered, or destroyed by mechanical action. An iron bar, entirely neutral as to its molecular magnetism, as shown by its being devoid of influence when placed horizontally in an east and west line near a compass, became strongly magnetic when

placed upright or proximately so, had its polarity reversed by turning it with the contrary ends downwards, and again became neutral when placed on the horizontal east and west line. If the same bar, while held in an upright position, or inclined in the axil direction of the earth's magnetism, were subjected to percussion, or other mechanical violence, not only did its magnetism become much more powerful than that of simple induction, but it strongly exhibited its augmented polarity when placed in the east and west neutral or equatorial position, and, however it might be moved about or swung round, its polarity remained the same. Having proved these two propositions by experiment, Dr. Scoresby went on to apply them to the case of iron ships, and to point out that, in consequence of the percussive action to which the material was exposed while the ships were in course of construction, it became as intensely magnetic as it was possible for malleable iron to be. This augmented magnetism, however, was not permanent or fixed, but, under different circumstances as to the relative deviation of the ship's magnetism and that of the earth, was easily changeable, and liable necessarily to be changed. The magnetism developed by mechanical violence could readily be neutralized or changed, under a proper change of conditions, by other processes of mechanical violence. If the bar of iron magnetized by hammering were held in the reverse direction from that in which the magnetism had been developed, and again hammered, the polarity would not only be altered, but reversed. Again, after well hammering the bar in a vertical position, let it be quickly reversed, the lower end, as hammered, now being upwards, and let one of its extremities be then presented to a delicate compass; the deviating influence in this case would be but small, perhaps a few degrees only, from the influence of the earth's magnetism, it being now augmented by the increased magnetism of the bar. If, while held in this position, a single blow were struck on the bar with a hammer, the needle would be seen to fly round as if by magic, and settle at a point of deviation perhaps four or six times as great as before. The result of another experiment which had been made with elongated plates of iron, to elucidate the phenomena of mechanical violence or vibration, had been still more remarkable. Take a couple of iron plates laid together; it was found when their condition was neutral, that held within two or three inches of a compass, horizontally east and west, there was no action whatever on the needle; but, holding the plates upright and bending them, or shaking them with the hand, or merely giving them a vibratory shake, and then presenting them as before to the compass, the iron was found to have become very strongly magnetic, the end which was downward repelling the north pole of the needle. Reversing the position of the plates, while held upright, let the vibratory action be repeated, and the end formerly repelling will now be found to attract the north end of the pole. Repeating the vibratory action, while the plates were held horizontally in an east and west line, the magnetism would be found, on bringing the plates to the test, to have disappeared, all action of the compass having gone. To meet probable objections, he had

made experiments on rolled iron plates, of the same kind as those of which ships were generally built, and had ascertained that the magnetism in these also was changeable and controllable like that in bar iron, under the requisite change of position, by vibratory or percussive action. He had also made experiments on a portion of a plate cut out of the side of a ship recently built, and the result of his observations was to establish the fact that, besides the two denominations of magnetism ordinarily received, that of simple terrestrial induction and that of permanent independent magnetism, there was another denomination corresponding with neither; not being absolutely controllable, like the former, by terrestrial influences, nor capable, like the latter, of resisting all kinds and modes of mechanical violence. To this third denomination he gave the name of "retentive magnetism." Dr. Scoresby then exhibited experiments with three sets of plates, two of iron and one of steel, for the illustrating of these several qualities of magnetism:— 1. That of simple terrestrial induction by iron plates free from polarity, which became magnetic, or changed their magnetism, according to the position in which they were held. 2. Retententive magnetism, as illustrated by similar plates, which had been previously magnetized by bending and blows,—such magnetism appearing as if permanent when the plates were moved about, without being vibrated or bent. And, 3rdly. Permanent magnetism, as illustrated by an elastic steel plate, which, however violently it was bent, or struck, or vibrated, or in whatever position, still preserved its magnetism unaltered. Now, this retentive magnetism was the quality which had been prevalently considered as permanent; which he was prepared to show, both by experiments on iron and facts of experience, was by no means a fixed quality. The vibration of a ship in a heavy sea was sufficient to change the original magnetism developed and augmented in the course of her construction. A great deal depended on the position in which the ship had been built. In the case of the Tayleur, when he first heard of the catastrophe and read the evidence, he had stated to some friends at Torquay that he would venture to predict that she had been built with her head to the north. He had found, on inquiry, that she had been built with her head nearly northeast. Here, then, were the precise circumstances for expecting a change in the ship's magnetic distribution. Having been built with her head to the northeast, she had a certain magnetic distribution; and when she began to strain with her head to the southwest, that distribution was necessarily changed, and the first effect of it had been to alter the two compasses adjusted by fixed magnets. If the captain had been aware of the changes which might, and most probably would, take place when the ship began to strain in a different position from that in which she had been built,—if he had known that the compasses might vary as much as two, or three, or even four points,—he would have known, of course, that he must place no reliance upon them. It did not follow, however, that compasses were of no use because, under circumstances, they were liable to change. They ought to be, and were, of great use for all that. But what he wished to

impress upon them was, that, by attempting to adjust a transient influence by a permanent influence, they were only aggravating error; that captains ought always to bear in mind this liability of their compasses to mislead them two or three points; that they should be always looking after their correction and verification whenever the sun or a star was in sight; and that, by keeping a compass aloft as far as possible from the iron of the ship, they would always have a standard to which they would be able to refer, and which he, in his Arctic voyages, had always found to be correct.

At the conclusion of Dr. Scoresby's paper, an animated discussion took place, in which an opposite position from that taken by Dr. S. was assumed by Mr. Grantham, of Liverpool. He said, that the effect of the arguments of Dr. Scoresby, if they made any impression at all, would be to put a check to one of the greatest improvements of modern times. If the idea should get abroad that wooden vessels only must be made the medium of communication, and that iron ships were dangerous, the mercantile marine of this country would be greatly injured. They all understood and admitted that there was an immense amount of local attraction disturbing the compasses of every iron ship, but he contended that sufficient was done to correct these errors; and he himself, from an experience of twenty years, closely watching the subject, and employed professionally to examine these very compasses, declared his opinion that the impressions left upon the minds of many, where a single case, like that of the Tayleur, was brought before their notice, were altogether erroneous. Dr. Scoresby had alluded to the cases of the Tayleur and the Birkenhead in depreciation of iron ships. He (Mr. Grantham) would ask him to take equal pains to ascertain the scientific reasons which had caused so many ships—wooden ships—to go ashore in the Irish Channel and in the Solway Frith. If equal logic had been made use of to show how these losses arose, instead of taking one or two isolated cases, and forgetting altogether the total amount of human life lost in wooden ships, they would find the losses of iron ships were very much less than the losses of wooden ships, in proportion to their comparative number. Dr. Scoresby had instanced the increased polarity of a bar of iron when its form was changed, or when it was struck with a hammer. But this argument was founded on the supposition that an iron ship was a single bar of iron, and that she should receive a blow from a mighty instrument in a certain position. There would, no doubt, be some alteration in the ship's compasses, if such a thing was possible; but he would ask the question how and when a ship could get such a blow. Dr. Scoresby also maintained that, if a bar of iron was bent, it would alter its polarity, but they must therefore suppose the ship to be twisted and bent about. If she did so, every plate would open, and she would inevitably founder. He called upon them to look at the channel, full of iron ships, and those kind of ships most liable to vibration—that is, long ships, with most powerful engines on board of them. If those present had, like him, looked over those vessels twice a year, they would see how little they were affected, comparatively. One

result of his inspection was, that he found that the compasses of iron, as a whole, were quite as correct as the compasses of the same number of wooden ships. He (Mr. Grantham) had been employed by the Admiralty to examine the place where the Tayleur was lost; and his impression was, that she was not lost through any error in her compasses. He believed that no prudent captain, knowing the Channel, would venture to beat about in it for three or four days during a heavy gale without using the lead; and it was proved that Capt. Noble had neglected this precaution. As to the loss of the Birkenhead, was there no ship ever before run upon the point of a reef by "cutting it too fine"? In his experience for twenty years, in close connection with the building and management of iron ships and steamers, he was confirmed in the belief that there was nothing to prevent them from being navigated as safely as wooden ships. And he believed that, in general, the compasses of iron ships were more correct than the compasses in ordinary wooden ships, simply because more attention was paid to them. Under these circumstances, he wished to caution the mercantile community not to allow themselves to be influenced by particular and striking cases such as had been alluded to, but to look at the whole subject—to look at the mass of iron ships that had been built and worked, safely worked, for years and years—and then see whether the combined information to be derived from all that were properly managed at all bore out the inferences likely to be drawn from the statements which had unfortunately, he thought, been so elaborately made.

Mr. Towson said that he had, equally with Mr. Grantham, had the opportunity of observing the workings of compasses in iron ships, and he had never found that after going a long voyage they were in a proper state of adjustment. No one believed more than himself in the importance of the progress of iron ships to the mercantile progress of the country, but he considered it impossible at present to obtain a correct compass in an iron ship.

In the course of the discussion which followed, Admiral Beechy expressed a belief that the best precautions against accident would be the use on board every ship of an azimuth compass, and the taking of frequent observations.

Dr. Scoresby, in reply, owned that the subject he had chosen involved a considerable shock to the feelings, as it affected Liverpool and iron ships. But they ought not to be afraid of the truth, or to shirk it for fear of the consequences. By going to the root of the thing, they might be in hopes of arriving in time at a practical remedy.

OPINIONS OF PROF. AIRY, ASTRONOMER ROYAL, ON THE DEVIATION OF COMPASSES IN IRON VESSELS.

The above paper of Dr. Scoresby, and the discussion and attention it excited in the British Association and among the maritime public, have called forth a communication from Prof. Airy, the Astronomer Royal of

Great Britain, on this subject. In this communication, published in the *London Athenæum*, he says :—

I have deep satisfaction in remarking that the great principles upon which I founded the method of correcting the compass are entirely recognized by Dr. Scoresby, and even that some minor modifications of those principles (which, as will appear in the remarks below, I had anticipated as probable) have now been established by Dr. Scoresby's beautiful experiments. In the estimation of the actual extent and rapidity of the changes produced by these modifications, I may perhaps differ in some measure from Dr. Scoresby, and I may be disposed to recommend a practical course slightly different from that which he would propose. Still I am happy to find that upon the fundamental points of the theory we are in complete accordance.

1. It may perhaps be advantageous to give a few steps of the history of this subject. The law, that the greater part of the disturbance of the compass produced by an iron ship depends upon its *polar*, and not upon ts *induced*, magnetism, (in the ordinary sense of the word *induced*,) was established by me in a paper printed in the "*Philosophical Transactions*" for 1839. The experiments themselves had been made in 1838. In page 212 I observe :—"The most remarkable result, in a scientific view, from the experiments detailed above, is the great intensity of the permanent magnetism of the malleable iron of which the ship is composed. It appears, however, that almost every plate of rolled iron is intensely magnetic." (It is to be noted that I used the term *permanent* magnetism as equivalent to *polar* magnetism.) I then allude to experiments on the magnetism of plates of wrought iron; and these experiments were the last with which I had any acquaintance until I saw some of Dr. Scoresby's beautiful illustrations of the change of magnetism of iron plates. In page 213 I remark :—"It seems sufficiently probable that the independent [polar] magnetism of the ship will change with time. This consideration enforces strongly the necessity of periodical examination as suggested above." This is all that was printed by me in reference to the change of the polar magnetism of ships and their occasional examination; but it is not the only instance in which I endeavored to bring them before the notice of the proper authorities. In 1839, July 20, I submitted a memorial to the Board of Admiralty on the advantage of a supervision, by the government, of the correction of the compass in iron ships, in which occur the following remarks :—"There is no reason for presuming that the magnetic state of the ship (especially in the case of steam-ships) will remain invariable for many years; and there is reason for supposing that it will vary." "Experiments of various kinds and in various localities should be made on the same ship, for ascertaining whether there is sensible change in different parts of the earth." And with regard to the magnets :—"The important results lately arrived at by Mr. Scoresby, and wholly unknown to the persons commercially engaged in the fabrication of magnets, show that attention to those points on which the permanency of

the magnetism depends cannot be expected from common tradesmen." The Admiralty (I believe in accordance with precedent and with the rules of the department) declined to undertake the supervision for commercial ships; and, as no other iron ships then existed, this decision amounted practically to a refusal to enter on the matter. Had the subject been then taken up by the government, it might perhaps have been advanced several years. I did myself endeavor to collect information, and I took notes of the position in which one ship was built; but the occupations of a laborious office compelled me to desist. I may mention, that in almost every instance reported to me, in which the correction failed after a time, I had reason to think that the failure arose from change, not in the ship, but in the correcting magnets; and this consideration, combined with the feeling of want of leisure, prevented the extension of my inquiries.

2. I am deeply struck with the beauty and the importance of Dr. Scoresby's experiments; and if I bring to notice the circumstance, that the polar magnetism of iron plates, and the possibility of change in the magnetism, were first strongly insisted on by myself, I trust it will not be understood that I mean to say that those experiments are unessential to our present knowledge of the subject. Still, as the first who examined into and speculated upon this subject, I claim the right of criticizing the name which Dr. Scoresby has proposed: and I express my opinion that "retentive" ("retained" would be better in a grammatical sense) does not exactly represent the characteristics of the magnetism of wrought-iron plates. The latter appears to me to differ very little from the magnetism of hard steel bars. A steel bar is magnetized by induction—(as in an iron plate)—a steel bar may have its magnetism weakened or reversed: if immersed in the sea-water, it would probably lose its magnetism sooner than an iron ship would. But as, in practice, the magnetism of an iron ship is *slightly* more liable to change than that of a steel magnet *very carefully* preserved, it may be desirable that a name, expressive of that idea, should be given to it. I would propose to call it the "sub-permanent polar magnetism of wrought iron."

3. I think it likely that the striking character of Dr. Scoresby's experiments produces an impression of the extent of their applicability to iron ships far greater than is warranted by careful consideration. We may speak poetically of the shocks which a ship receives from the waves; but, in reality, the plates of iron of which a ship is composed sustain no such shocks. The direct effect of the most violent sea upon them is this: that, in the course of two or three seconds of time, the plate is plunged five or six feet deeper in the water, and sustains the corresponding hydrostatic pressure. This is very different, indeed, from the raps or slaps in Dr. Scoresby's experiments, in which it is essential that the blow be of the nature of impact, occupying a very small fraction of a second of time. Probably the strain of extension to which the plates are subjected may produce a greater effect: on this, however, experiments are wanting. But, even here, the change in the state of extension is not sudden, but gradual.

The tremor produced by steam-power is more likely to affect the plates in some parts of the ship. It is evident that there are causes in action tending to produce effects like those exhibited in Dr. Scoresby's experiments, and it is equally evident that the action of those causes must be exceedingly slow. On one point, however, I trust that a consideration of Dr. Scoresby's experiments will disabuse many persons who have not been well acquainted with the nature of induction and sub-permanent magnetism. The change to be expected in a ship's sub-permanent magnetism, in sailing from England to the Cape of Good Hope, does *not* essentially depend on her passing into another magnetic hemisphere. It *does* depend mainly on this circumstance: that, supposing her to have been built with her head to the north, or in the line of boreal magnetism, she is then turned with her head to the south, or in the line of austral magnetism, and is so kept, exposed to slight tremors, for one or more months. If she had been moored off the coast of Portugal for the same time, in the same position, and exposed to the same tremors, I apprehend that her magnetism would have undergone nearly the same change (as regards horizontal deviation of the compass) as in the voyage to the Cape of Good Hope.

4. I think the selection of the loss of the Tayleur, as the text for the principal discussion on iron ships, with all its attendant horrors, (having no application whatever to the matter under discussion,) was unfortunate. When the feelings are excited, the judgment of the speaker, as well as of the hearers, is very liable to be perverted. The question at issue is the very abstract one: Is it likely that in two days the magnetism of a ship could be so much changed that the compass would be disturbed through an angle of two points? I unhesitatingly answer: It is not likely; and, speaking with our present knowledge on the subject, it is not possible. I have already stated, that I conceive the causes pointed out by Dr. Scoresby to be wholly inadequate to produce such a rapid change. And I aver, that there is no known instance of such a change; and I do not believe that an instance can be produced of a rapid change of one-fourth or one-tenth part of this amount. I believe that information on these matters is not wanting: a single firm in Liverpool have "corrected" the compasses in several hundred iron ships, and they cannot fail to have received notification of any such changes as those mentioned above.

Before dismissing this subject, I will advert to two sources of error, not essential to my method of correcting the compass, but to which it may be liable if due care is not exercised. The first is, that captains are hardly aware that a very trifling disturbance in the position of the compass (for instance, a change of a quarter of an inch in the height) may very greatly disturb the neutralizing influence of the magnets. The second is, that the artists who correct the compasses are too much inclined to place the correcting magnets in the position called "end-on." In this position, the magnet exerts greater deflective power, but it also introduces a force perpendicular to the ship's deck; and this force, when the ship heels, produces an uncorrected horizontal disturbance. While the building in

iron was principally confined to paddle steam-ships, this was not important; but now, when so many screw steam-ships and sailing ships are built of iron, this arrangement ought never to be used. I know not whether the compasses of the Tayleur could have been affected by either of these causes.

5. The question, however, which immediately presses, is: What (under all circumstances) is it best to do now? In answer, I assert in the first place, and I am supported in this by Dr. Scoresby's experiments, that the source of local disturbance and its laws are perfectly well known; that the disturbance can be neutralized, by well-known means, to the greatest exactness; and that this neutralization is perfect during change of time and change of place, until the ship herself undergoes an organic change. In the next place, I protest strongly against the system, now in use (I believe) in the Royal Navy, of using a table of errors, and thus constantly making numerical corrections instead of once making a mechanical correction. (1.) It is baffling to the mariner. (2.) It is liable to exactly the same errors, in the event of a change in the ship's sub-permanent magnetism, as the system of relying on the mechanical correction. (3.) It is liable to errors peculiar to itself, which would be entirely avoided by the use of mechanical correction. In illustration of the last remark, I will refer to the table, in page 104 of the late Capt. Johnson's book, on the "Deviations of the Compass," second edition, a work in many respects highly valuable. Capt. Johnson has given the observed deviations of the compass on board three iron steam-vessels in different parts of the world; and I select the last, (the Trident,) because its deviations were the largest. The deviations in the Thames ranged from 22° 15′ E. to 21° 12′ W. The deviations of the same compass at Malta ranged from 15° 29′ E. to 14° 21′ W. Now, the proportion of the terrestrial, horizontal magnetic forces, in the Thames and at Malta, is as 52 to 75, very nearly. Therefore, if the ship's sub-permanent magnetism remained unaltered, the tangents of the angles of deviation in the Thames and at Malta would have been in the proportion of 75 to 52. On computing the Malta deviations from those in the Thames by this proportion, we obtain 15° 50′ and 15° 3′, agreeing with those observed more nearly than observations can be made with a ship's compass. The whole of the deviations recorded by Capt. Johnson, for the Bloodhound, the Jackal and the Trident, at Lisbon, Constantinople, the Piræus, and Malta, can be computed in the same way from those in England, and the results are equally accordant. (The terrestrial horizontal forces, on the same scale of proportion, are, Lisbon, 60; Constantinople 77; Piræus, 76.) It follows from this, that the ship's sub-permanent magnetism, in each case, was unaltered, and its effect would have been exactly compensated, at every locality, by a permanent magnet. And thus the captain of the Trident, using Capt. Johnson's table, would have had errors of nearly seven degrees; whereas, if he had used my correcting magnets, he would have had no perceptible error in the whole voyage. I pointed out this result to Capt. Johnson; I know not with what effect.

(4.) In extreme cases it cannot be used at all: thus, in the Greenland seas the compasses would sometimes turn round with the ship; whereas there are in the Greenland seas several iron ships with my correcting magnets effecting their purpose (I am informed) successfully. (5.) In cases not so extreme, the inconvenience is intolerable; thus, in one instance which came under my own eyes, the compass changed 100° with a very small motion of the ship; and the directive intensity in one position was only one-tenth of what it was in another position; these inconveniences are entirely remedied by my correcting magnets.

On considering the whole matter, I am led to give the following as my opinion: For voyages of moderate duration, as, for instance, not farther than to the Mediterranean or to the northern parts of North America, I do not think that any improvement can be made in the existing system, except in details; to which I have alluded. The "end-on" position of the magnets ought to be forbidden; and some attention ought to be given to the ship's sub-permanent magnetism, in the direction perpendicular to the deck. For voyages of greater duration, as to the Plata, the Cape of Good Hope, &c., I think it desirable that means should be provided for enabling the captain to make the small changes which may be required in the correcting magnets. I am confident that I can point out a practical course by which this can be effected; and I am satisfied that, with the sanction of one liberal ship-owner, the aid of one intelligent captain, and the command of one ship for a few days, I can arrange every thing with good hope of complete success.

6. The remarks above are intended by me to apply only to iron-built ships, in which the sensible part of the disturbance of the compass is produced almost entirely by the ship's sub-permanent magnetism. In wood-built ships, in which the induced magnetism is the principal disturbing power, the rules of correction are necessarily different. On these, at present, I have only to make the same general remark which I have made above; that I disapprove of the use of a table of errors, and that I prefer the use of mechanical corrections; the nature of which, as applicable to the neutralization of induced magnetism, is perfectly understood.

ON IMPROVEMENTS IN SUBMARINE AND SUBTERRANEAN TELEGRAPHIC COMMUNICATIONS.

At the British Association, 1854, Mr. C. F. Varley explained experiments he had made with gutta-percha covered wires, varying from 30 to 1,500 miles in length, and showed a diagram drawn by the electric currents themselves, decomposing solutions of ferro-cyanide of potassium and nitrate of ammonia with which the paper had been saturated. These experiments showed that the electric current did not appear *suddenly* at the extreme end; but, the wire becoming charged by induction like a Leyden jar, the current commenced gradually, and did not reach its maximum power through 1,500 miles of wire until seven seconds of time had

elapsed, and continued flowing out seven seconds after contact with the battery had ceased; that with the ordinary telegraphic systems such a wire would require 15 seconds of time to make each signal; and as several signals are required for a letter, only one average word could be transmitted per three minutes. Mr. Varley showed that, with the submarine and subterranean wires between Holland, London, and elsewhere, the Bain and Morse instruments would work too slow for commercial purposes; but, with the aid of his apparatus, these wires are now and have been working for six months at the required speed, viz.: 25 words per minute, for which 300 alterations of current per minute are required. The effect of the former two telegraphs with these wires, when working fast, is to run all the marks together, because the first electric impression has not been completed when the second is given; but his apparatus, by spilling the charge and reversing the current at every movement of the key, produces rapidly alternating currents through the wire, which, though very weak at the extreme end of the wire, are quite sufficient to actuate his galvanometer relay, which actuates a *local* battery to produce the marks. The little arm on the axis of the relay, instead of striking against a dead stop, rubs obliquely against a gold spring, filing off the little film of air which would otherwise prevent the instant completion of the local circuit. So sensitive is this apparatus, that four elements of a copper and zinc battery have been found sufficient to work from Manchester to London. He added, "Its advantages over the needle systems are, it requires only one wire, gives a printed record of all communication, requires but one-fourth the power to actuate it, and is not interrupted by comparatively defective insulation. It gains these advantages: 1st. By discharging the line wire at every move of the key. 2d. Gravity aiding the electricity in making the relay contact, thus using the same instead of the difference of the forces. 3d. The sliding action of the relay contact, by rubbing off the thin film of air, gives sure and instant contact with a small amount of battery power. 4th. It will work through a considerable amount of leakage from one wire to the other, because there is a current always flowing through the wire, rendering this apparatus peculiarly adapted for wires suspended in the air, and which leak from one to the other in damp weather, the surfaces of the intended insulators becoming coated with moisture."

The following are Mr. Varley's conclusions: 1st. If a wire could be suspended in an unbounded non-conductor, or atmosphere with no conducting body near it, the transmission of an electric current through it would be instantaneous, no matter what may be the length of the wire. 2d. The approach of any conducting body to this wire would (by induction) reduce the speed of the transmission, as shown in the 1,500 mile experiment. 3d. In the case of a wire covered with a non-conducting substance, (such as gutta-percha,) the induction decreases in the same proportion that the thickness of the coating is increased. 4th. The conducting power of a wire is in proportion to its substance, the induction in

proportion to its surface. A copper wire one-sixth of an inch in diameter, coated with gutta-percha to the depth of nearly half an inch, would be found capable, by aid of my apparatus, of transmitting 25 words per minute 3000 miles. To work the ordinary telegraphs, the copper wire must be three-eighths of an inch in diameter, and coated with gutta-percha three-fourths of an inch, making a total diameter of about two inches.

ON THE CONSTRUCTION OF A SUBMARINE TRANSATLANTIC TELEGRAPH.

The following communication, on the feasibility of constructing a submarine line of telegraph across the Atlantic, has been addressed to the Secretary of the Navy by Lieutenant Maury :—

SIR :—The United States brig Dolphin, Lieutenant Commanding O. H. Berryman, was employed last summer upon especial service connected with the researches that are carried on at this office concerning the winds and currents of the sea. Her observations were confined principally to that part of the ocean which the merchantmen, as they pass to and fro upon the business of trade between Europe and the United States, use as their great thoroughfare. Lieutenant Berryman availed himself of this opportunity to carry along also a line of deep sea soundings from the shores of Newfoundland to those of Ireland. The result is highly interesting, in so far as the bottom of the sea is concerned, upon the question of a submarine telegraph across the Atlantic ; and I therefore beg leave to make it the subject of a special report.

This line of deep sea soundings seems to be decisive of the question as to the practicability of a submarine telegraph between the two continents, in so far as the bottom of the deep sea is concerned. From Newfoundland to Ireland, the distance between the nearest points is about 1,600 miles ;* and the bottom of the sea between the two places is a plateau, which seems to have been placed there especially for the purpose of holding the wires of a submarine telegraph, and of keeping them out of harm's way. It is neither too deep nor too shallow ; yet it is so deep that the wires, but once landed, will remain forever beyond the reach of vessels' anchors, icebergs, and drifts of any kind, and so shallow that the wires may be readily lodged upon the bottom. The depth of this plateau is quite regular, gradually increasing from the shores of Newfoundland to the depth of from 1,500 to 2,000 fathoms as you approach the other side. The distance between Ireland and Cape St. Charles, or Cape St. Lewis, in Labrador, is somewhat less than the distance from any point of Ireland to the nearest point of Newfoundland. But whether it would be better to lead the wires from Newfoundland or Labrador is not now the question ; nor do I pretend to consider the question as to the possibility of finding a

* From Cape Freels, Newfoundland, to Erris Head, Ireland, the distance is 1,611 miles ; from Cape Charles, or Cape St. Lewis, Labrador, to ditto, the distance is 1,601 miles.

time calm enough, the sea smooth enough, a wire long enough, a ship big enough, to lay a coil of wire 1,600 miles in length; though I have no fear but that the enterprise and ingenuity of the age, whenever called on with these problems, will be ready with a satisfactory and practical solution of them.

I simply address myself at this time to the question in so far as the bottom of the sea is concerned, and as far as that the greatest practical difficulties will, I apprehend, be found after reaching soundings at either end of the line, and not in the deep sea.

A wire laid across from either of the above-named places on this side will pass to the north of the Grand Banks, and rest on that beautiful plateau to which I have alluded, and where the waters of the sea appear to be as quiet and as completely at rest as it is at the bottom of a mill-pond. It is proper that the reasons should be stated for the inference that there are no perceptible currents and no abrading agents at work at the bottom of the sea upon this telegraphic plateau. I derive this inference from a study of a physical fact, which I little deemed, when I sought it, had any such bearings.

Lieut. Berryman brought up with Brooks's deep-sea sounding apparatus specimens of the bottom from this plateau. I sent them to Prof. Bailey, of West Point, for examination under his microscope. This he kindly gave; and that eminent microscopist was quite as much surprised to find as I was to learn that all these specimens of deep-sea soundings are filled with microscopic shells; to use his own words, "not a particle of sand or gravel exists in them." These little shells, therefore, suggest the fact that there are no currents at the bottom of the sea whence they came—that Brooks's lead found them where they were deposited in their burial place after having lived and died on the surface, and by gradually sinking were lodged on the bottom. Had there been currents at the bottom, these would have swept and abraded and mingled up with these microscopic remains the debris of the bottom of the sea, such as ooze, sand, gravel and other matter; but not a particle of sand or gravel was found among them. Hence the inference that these depths of the sea are not disturbed either by waves or currents. Consequently, a telegraphic wire once laid there, there it would remain, as completely beyond the reach of accident as it would be if buried in air-tight cases. Therefore, so far as the bottom of the deep sea between Newfoundland, or the North Cape, at the mouth of the St. Lawrence, and Ireland, is concerned, the practicability of a submarine telegraph across the Atlantic is proved.

In this view of the subject, and for the purpose of hastening the completion of such a line, I take the liberty of suggesting for your consideration the propriety of an offer, from the proper source, of a prize to the company through whose telegraphic wire the first message shall be passed across the Atlantic.

I have the honor to be, respectfully, &c.,

M. F. MAURY, Lieut. U. S. Navy.

Hon. J. C. Dobbin, Secretary of the Navy, Washington, D. C.

TRANSATLANTIC TELEGRAPH.

In a recent communication to the Journal of the Frankln Institute, on the subject of trans-telegraphic Atlantic communication, Dr. L. Turnbull, well known for his acquaintance with telegraphic operations, presents the following points respecting the consummation of this great enterprise :—

1st. "To find a time calm enough and a sea smooth enough to lay down a telegraphic cable." In my own mind, this first difficulty can be overcome as easily as the observations of Lieut. Berryman were made; if times of calm are found for such careful observations as he has conducted, by means of a twine string so as to let down a cannon ball of sixty-four pounds, and then raise a tube filled with shells and earth of the depths of the ocean, we are almost certain a time calm enough and a smooth sea can be found to stretch a wire from cable from land to land.

The second difficulty is, a "wire long enough." On this point we have accurate data to follow. The cable from Calais to Dover is twenty-four miles long, and consists of four copper wires, through which the electric currents pass, insulated by coverings of gutta-percha. These are formed into a strand and bound round with spun-yarn, forming a core or centre, around which are laid ten iron galvanized wires of 5-16th of an inch in diameter, each welded into one length of 24½ miles, and weighing about 15 tons per mile. The rope weighs altogether about 180 tons. It formed a coil of 30 feet diameter outside, 15 feet inside, and 5 feet high, and was made, in the short space of twenty days, by a machine invented for the purpose. The transatlantic cable, if the machinery is multiplied and sixteen machines are employed, could, we have little doubt, complete the cable in six or seven months.

The third difficulty is, "a ship big enough." This can be no difficulty; for if one would not do, twenty would. What is the objection to sending it by trips, or in pieces? Could it not be attached, as it was laid down, to a *buoy?* A vessel of 1,000 tons could surely carry 400 tons of coil, for our cable would not exceed 12,000 tons.

Another important matter to be determined is, to what extent a galvanic current can be sent on an insulated wire. This has been also determined; for, in favorable states of the atmosphere, lines in this country have been so insulated as to work in one circuit from 800 to 1,000 miles. The greatest distance that any of the lines have ever worked in one circuit was from Boston to Montreal, via New York, Buffalo, and Toronto—a distance of about 1500 miles. This was done when the earth was frozen and the lines insulated by frost. The entire length of the telegraph line from New York to New Orleans is 1,966 miles, via Charleston and Mobile; and even this distance has been worked in one circuit by the aid of an instrument termed the connector, the effect of which is to cause one circuit to work the other through the entire series, thus producing a result similar to working through the entire line in one circuit.

As late as December, 1853, despatches were written direct through from New Orleans to Philadelphia and New York, the weather being cold and the earth frozen. In so doing, the only connector or repeater used was an insulated screw on the back of the register, invented by Mr. McRea, of Philadelphia. But this distance would require at least 30 Grove's cups, of a pint each, for every 100 miles; making about 480 cups, or 240 each side. If a copper and zinc battery were employed, the number would have to be increased to about 30 or 40 cups, every 100 miles; but, even with this large battery, the expenses would be less than with Grove's battery. In preparing the batteries, it is even possible to determine mathematically beforehand the amount of resistance and the force necessary to overcome it, and thus to proportion the number and size of the plates to the distance to which the wires extend. Large wires are better conductors than small ones; copper is a much better conductor than iron; and as a thinner wire answers the purpose of conduction, it may be much more easily insulated. The several conditions may all be calculated from the beautiful formula of Ohm.

In some recent experiments of Prof. Farraday, that distinguished philosopher, by some of the experiments he obtained, has thrown much light upon the action of voltaic electricity in the submerged wire of the electric telegraph.

He first determines by actual experiment, that when copper wire is perfectly covered with gutta-percha, so high is the insulation, that in 100 miles of such wire, when fully charged by an intensity battery of 350 pairs of plates and submerged in water, the deflection of a delicate galvanometer was not more than 5°. The great perfection in the covering of the wire may be judged of by this fact alone. The 100 miles of wire were one-sixteenth of an inch in diameter; the covered wire was four-sixteenths; the gutta-percha on the metal was considered as 0.1 of an inch in thickness. There could not be any better proof than this, that gutta-percha is one of the best ins ulating agents we have.

He experimented with the subterraneous wires which exist between London and Manchester; and when they were all connected together so as to make one series, they made almost the distance as determined by Lieutenants Berryman and Maury between the Irish coast and Newfoundland, being 1,500 miles; and having introduced galvanometers at intervals of about 400 miles, he found that, when the whole 1,500 miles were included, it required *two seconds* for the electric stream to reach the last instrument which was placed at the end. In this instance the insulation was not as perfect; still the result shows that it will require a little over two seconds to cross the Atlantic by telegraph, which is about the rate of 750 miles in a second, which result is far below those obtained by the London and Brussels telegraph, which is stated at only 2,700 miles in a second, even with a copper wire; while it will be remembered that Wheatstone, in 1834, with copper wire, made the velocity of the electric current 288,000 miles per second—a considerable difference.

The whole of this difference, according to Professor Farraday, depends upon the lateral induction of the wire carrying the current. "The production of a polarized state of the particles of neighboring matters by an excited body constitutes *induction*, and this arises from its action upon the particles in immediate contact with it, which again act upon those contiguous to them; and thus the forces are transferred to a distance. If the induction remain undiminished, then perfect insulation is the consequence; and the higher the polarized condition which the particles can acquire or maintain, the higher is the intensity which may be given to the acting forces. In a word, insulators may be said to be bodies whose particles can retain the polarized state; whilst conductors are those whose particles cannot be permanently polarized." And in regard to long circuits such as those described, their conducting power cannot be understood; whilst no reference is made to their lateral static induction or to the conditions of intensity and quantity which then come into play.

The conducting power of the air and water wires are alike for a constant current. This, according to Farraday, is in perfect accordance with the principles and with the definite character of the electric force, whether in the static, or current, or transition state. When a voltaic current of a certain intensity is sent into a long water wire, connected at the farther extremity with the earth, part of the force is in the first instance occupied in raising a lateral induction round the wire, ultimately equal in intensity at the near end to the intensity of the battery stream, and decreasing gradually to the earth end.

In the report of Farraday, which is given in the London *Philosophical Magazine* for March, he there, in conclusion, refers to the terms *intensity* and *quantity*. These terms, he remarks, or equivalents of them, cannot be dispensed with by those who study both the static and dynamic relations of electricity. Every current, where there is resistance, has the static element and induction involved in it, whilst every case of insulation has more or less of the dynamic element and conduction; and we have seen that the same voltaic source, the same current in the same length of the same wire, give a different result, as the intensity is made to vary with variations of induction around the wire. The idea of intensity, or the power of overcoming resistance, is as necessary to that of electricity, either static or current, as the idea of pressure is to steam in a boiler, or to air passing through apertures or tubes; and we must have language competent to express these conditions and these ideas.

In conclusion, I trust that a cable may be laid across the briny deep, and I am happy to find the matter taken hold of by intelligent and scientific telegraphic engineers; and its completion will be one of the wonders of the age.

In relation to the ultimate completion of the transatlantic submarine telegraph, Mr. Shaffner, a gentleman who has had considerable experience in submarine telegraphic lines during the last five years, employs the

following language, in regard to this enterprise, in the first number of a journal of which he is the editor :—

"Tides may ebb and flow; the billows may surge with mighty power; the icebergs may tower their white-mantled forms high in the skies, and sink deep in the briny sea; the heavens may let loose their loud-rolling thunder, and the earth heave up its fiery lava; but, just so sure as these elements exist and worlds revolve, Europe and America will be connected with an electric cord."

In a paper presented to the British Association by Mr. Bakewell, on "Telegraphic Communication between England and America," he proposed to effect such a communication by employing a single galvanized iron wire sufficiently strong to be self-protective, and to be insulated with gutta-percha or other non-conducting substances, covered with tarred hempen yarn. Such a wire, it was stated, might, from its comparative lightness and flexibility, be readily stretched across the Atlantic at a cost of 100,000*l*. A single wire would, in the first instance at least, be sufficient to supply the want of telegraphic communication, if the telegraph were kept in constant work. Mr. Bakewell alluded to the difficulty that had recently been discovered in transmitting telegraphic signals through an insulated wire immersed in water, and to the means that had almost as quickly been devised for overcoming the unforeseen obstacle. He expressed a confident expectation that, should other difficulties arise in prosecuting such an enterprise, they would also be as readily vanquished.

Dr. Lardner states that, in the experiments made by him and M. Leverrier in electric transmission, messages were sent over a space of 1,000 miles of wire without intermediate battery power, and with a terminal battery of very limited power; 336 miles of the wire upon which the current was transmitted were iron, a very indifferent conductor, and the remaining 746 miles were copper wire of exceedingly small diameter. It is certain, therefore, that by reason of the inferior conducting power of the one part, and the very small transverse section of the other part, this length of 1,082 miles offered a much greater resistance to the transmission of the current than would 1,600 miles of copper wire such as is usually selected for submarine cables. Nothing would be easier than to give the copper wire enclosed in the cable such a thickness, and to apply to it such batteries as would insure the transmission of a current of sufficient intensity.

SUBMARINE TELEGRAPH BETWEEN EUROPE AND AFRICA.

At the British Association, in a communication on the above subject, presented by Mr. Brett, the eminent telegraph engineer, the author proceeded to give an account of the difficulties and prejudices they encountered in establishing the first submarine telegraph, which has now been successfully working for three years between France and England, and stated that he had established the submarine telegraph between

England and Belgium with equal success, which had been in operation since the 1st of May, 1853. He then explained some of the difficulties he had encountered in laying down the two submarine lines in the Mediterranean in July last, especially in passing a depth exceeding, by 100 fathoms, what had previously been ascertained to exist on the route between Piedmont and Corsica. The depths encountered between England and France, and England and Belgium, did not exceed at their maximum 30 fathoms; whereas the submarine cable was laid down in the Mediterranean at a depth of 350 fathoms, exceeding about eight times that of the English Channel. It was the general impression that the submarine cable would part by the great strain it would encounter in passing these great depths; for which reasons he was strongly advised, and more particularly by one of the most able and experienced officers of the Sardinian Government, who accompanied and aided the undertaking, to make a *détour* of about eight miles by the Islands of Gorgona and Caprija, where the soundings were known not to exceed 100 fathoms; but the great point to be considered was, whether he would not incur the risk of a total loss of the cable by not doing so. The prudence of these arguments, Mr. Brett said, he fully admitted, but that it was a question he was determined to solve at once; for as this telegraph was not a telegraph to Corsica, but part of a line to India, to be shortly completed to Africa, where still greater depths must be encountered, it was necessary to test the fact. He then explained the difficulties they encountered in paying it out, when, after the line had been paid out, as he believes, along the top of a submarine mountain for some miles at a depth varying from 180 to 200 fathoms, it suddenly, as he believes, came to the edge of a precipice, making a total of 350 fathoms, (exceeding by about 100 fathoms any depth marked in the various charts on this route,) where it ran out with frightful velocity; and had the cable been less strong, the whole must, of necessity, have been lost; and they were compelled, nevertheless, to anchor by the electric cable all night, to restore the injury that had occurred; but he felicitated himself upon the experience thus gained from his determination in taking the deepest route, as it had led to many valuable suggestions necessary to successful operations in great depths; and the able commander, the Marquis Ricci, who up to this time had been in doubt of its success, then admitted that this kind of cable contained such remarkable elements of strength in its form and combination, that he believed only certain improvements to be necessary (on which we had been consulting) to successfully lay it down even in the greater depths of the Atlantic.

Mr. Brett, in conclusion, explained his reasons for selecting this line to India, via Egypt, in preference to the line by the Italian peninsula, which would ever be impeded by the jealousies and restrictions of the petty States; whereas, to the shores of Africa, the Mediterranean Telegraph passed through only the States of France and Sardinia, which had encouraged it by liberal guaranties, and admitted that all communications, in whatever language, should pass unrestricted through their states. From

Africa he stated he had two plans in contemplation for its extension to Egypt—one, a line dropped in the Mediterranean, in the shallow line near the coast, and another buried in the sand along the shore, both of which he was satisfied might be laid secure from derangement of any kind. He then concluded with a statement of the labor and attention he had given for many years in preparing for the telegraph to America, and of the depth, on the proposed line, as recently ascertained by Lieut. Maury, of the United States, with some estimates of the weight and cost, and stated that a return of 100*l.* to 150*l.* per day would give a fair interest on the necessary capital; that his plan comprised several lines of communication; and that he entirely deprecated the idea of a single line of communication, which he believed could not be done.

ELECTRIZATION BY INFLUENCE.

The French Academy has recently received a memoir of great interest from M. Melloni, on the subject of electrization by influence. The hypothesis which has hitherto prevailed to explain the general character of the phenomena relative to static electricity consists in admitting the existence of two imponderable principles, of two fluids endowed with reciprocal attraction each for the other, and with repulsion for themselves; and by this way the speculative philosopher obtains two agents possessing opposed properties, and susceptible under many circumstances of being disguised, or of being concealed by each other. At the first they were called vitreous and resinous electricity; and then, to exhibit more forcibly the antagonism of the way by which they acted, they were styled positive and negative electricity. No data having fallen into the philosopher's hands that might authorize him to define the absolute quantities of these fluids which might exist together in bodies, it has been supposed that ponderable matter contained infinite quantities of them, or at the least, quantities which may be regarded as infinite in comparison with the amount that may be excited in experiments. Notwithstanding this inexhaustible quantity of fluids contained in bodies, it suffices that one or the other is in the predominance to urge it to the surface, and to exhibit there the properties which are peculiar to it. This accumulation of the fluid in excess on the exterior surface constitutes the phenomenon of electrization. Consequently a body may be electrified by two different and opposite manners, as one or the other fluid predominates on its surface; in every case, the fluid in excess will exercise to escape a pressure, which is "electrical tension," properly so called. When the tension is great enough, the electricity appears in the form of a spark, whose dimensions may vary in enormous proportions. Between the phosphorescent sparkling of the stick of sealing wax rapidly rubbed and the dazzling lightning which rends our temples in sunder there is no difference other than a difference in degree.

The explosion of the spark is invariably preceded by electrization by influence, a so important phenomenon as to warrant some explanations.

If we remain faithful to the hypothesis of the fluids, the most simple way to electrify a body would assuredly appear to be by taking the fluid where it exists in a free state, and to communicate, to pour it out (if the expression may be allowed) as it were by a direct contact. This we see constantly used, when we witness a conductor sustained by some insulating support, placed in contact with an electrical machine previously charged: commonly the operator has not the time to place them in contact, for before they touch the spark leaps forward, and the division is made. And if the operator pleases to employ some known methods of observation, it may be seen that, during the period the two machines are being brought together, a change takes place in the state of the conductor, which greatly precedes the explosion of the spark. By the influence exerted within a certain radius of distance by the supposed machine charged with positive electricity, the natural distribution of the fluids is troubled; each of them has yielded to the disposition which characterizes it: the negative fluid advancing towards the positive fluid which attracts it, and the positive fluid of the bodies taking refuge in the parts of the surface farthest from the machine. The result is, the different points of this surface are inequally and differently electrified; in the hypothesis of a complete isolation, this state, which constitutes electrization by influence, would persist for an indefinite period. If, on the contrary, the machine be removed, or its charge be dissipated in the ground, the influence having disappeared, the conductor would immediately return to its natural state. Thus electrization by influence differs essentially from that which results simply from the accumulation of one or the other fluid. Here the same electricity is in the preponderance throughout the whole extension of the surface of the bodies; the tension is in every respect positive or negative, as is exhibited by the usual experiments of the electroscopic pendulum, and the *plan d'epreuve*, where neither the pendulum nor the body can regain their natural state, except by losing its fluid in excess, or by gaining the contrary fluid. There, on the contrary, electrization by influence divides the surface of the body into two distinct regions—one of the positive tension, the other with the negative tension; and these two regions are separated by a neutral line where the tension is null. Besides, the fluids thus localized in two distinct regions exist in proportions meet for the reformation of the neutral fluid, so that the operator has but to remove the acting cause to obtain this recomposition and to reconstitute the body in its natural state.

A clear distinction of the two phenomena is necessary to a perfect conception of the positions of Melloni. He commences his paper with recalling sententiously, as suited with his learned audience, these facts as having been definitively admitted in science, and as forming the foundation of the theory of static electricity; and then he announces that he has before him results from experiments which make a great breach in the fundamental theorem of electrization by influence.

According to Melloni, the *plan d'epreuve* and the electroscopic pendu-

lum, commonly employed to study the distribution of the electricities of a body electrified by influence, are not suitable to furnish exact indications, because they themselves are effected by the influence of the active body; and to protect them against this cause of error, he has imagined the expedient of interposing a metal plate, communicating with the common reservoir; the operator then has a body charged with an electricity acting by influence upon a neighboring body through the plate, which is a sort of screen to the organs of exploration. In these new conditions, Monsieur Melloni observes that the electricity on the surface of the body influenced is of the same nature and has the same appearances as that of the acting body, and he concludes: "This experiment dissipates the illusion hitherto formed, touching the contrary electric tensions developed on the opposite extremities of the influenced body."

These new ideas do not meet with the support of many others who have experimented upon this subject; they cannot admit that the metal plate introduced into the experiment acts simply as a screen; and some have suggested that the whole controversy rests on a misunderstanding, and that his reasoning follows somewhat the following course: dissimulated electricity is not the electricity of tension; but, in a body influenced within the radius of a given distance, one of the fluids is dissimulated; therefore, the other fluid alone retains its tension. But in reality, it is said, the two fluids retain their respective tensions, the instruments attest it; and in the opinion of natural philosophers, the true method of treating the question is invariably to consider the body as symmetrically placed between two contrary influences.

ELECTRO-MAGNETIC ENGRAVING.

This machine is somewhat on the principle of the well-known planing machine. The drawing to be copied and the plate to be engraved are placed side by side on the movable table or lid of the machine; a pointer or feeler is so connected, by means of a horizontal bar, with a graver, that, when the bar is moved, the drawing to be copied passes under the feeler, and the plate to be engraved passes in a corresponding manner under the graver. It is obvious that in this condition of things a continuous line would be cut on the plate, and, a lateral motion being given to the bed, a series of such lines would be cut parallel to and touching each other, the feeler of course passing in a corresponding manner over the drawing. If, then, a means could be devised for causing the graver to act only when the point of the feeler passed over the portion of the drawing, it is clear we should get a plate engraved, line for line, with the object to be copied. This is accomplished by placing the graver under the control of two electro magnets, acting alternately, the one to draw the graver from the plate, the other to press it down on it. The coil enveloping one of these magnets is in connection with the feeler, which is made of metal. The drawing is made on a metallic or conducting surface, with a rosined ink, or some

other non-conducting substance. An electric current is then established, so that when the feeler rests on the metallic surface it passes through the coils of the magnet, and causes it to lift the graver from the plate to be engraved. As soon as the feeler reaches the drawing and passes over the non-conducting ink, the current of electricity is broken, and the magnet ceases to act, and by a self-acting mechanical arrangement the current is at the same time diverted through the coils of the second magnet, which then acts powerfully and presses the graver down. This operation being repeated until the feeler has passed in parallel lines over the whole of the drawing, a plate is obtained engraved to a uniform depth, with a fac-simile of the drawing. From this a type-metal cast is taken, which, being a reverse in all respects of the engraved plate, is at once fitted for use as a block for surface printing. The machine is the invention of Mr. William Hausen, of Gotha.—*Journal of the Society of Arts.*

SPECIFIC HEAT OF GASES.

M. Regnault has presented to the Academy a very long memoir on the Specific Heat of Gases under constant pressure and variable volume, and under constant volume and variable pressure. After detailing the history of this important question, M. Regnault explained in a brilliant lecture his method of observation, the arrangement of his apparatus, and the important results he had obtained—results which entirely change the present state of the science, being in complete discordance with the theory of Laplace and Poisson, and with the observations of Désormes, Gay-Lussac and Dulong.

It has heretofore been admitted, that the capacity for heat under constant pressure is always greater than that under constant volume; and the ratio of these capacities is equal to unity plus a fraction, which, in air, is 338,000 according to Dulong, 375,000 according to Gay-Lussac, 421,000 according to Poisson, &c., &c. By operating in an entirely new mode, and under conditions that he thinks better, M. Regnault seems to have shown that the difference between these is nothing, or infinitely small.

Conceive two concentric globular vessels, one whose capacity is a litre filled with gas, air for example, under a pressure of ten atmospheres, the other with a capacity of ten litres. This system of two vessels is immersed in a water bath kept at a constant temperature. If, after having made a vacuum in the second globe, we allow the air to enter it from the first, so that it now occupies a bulk ten times greater, there is neither elevation nor depression of the temperature. There will be, however, a depression of the temperature, if, at the same time that the air enters the larger globe, a small quantity is allowed to pass out by an orifice in the globe; and the amount of depression of the temperature is constantly proportional to the mass of gas which has escaped into the atmosphere. If the air which escapes is made to do work, as for instance to move a turbine, re-action wheel, or pump, the cooling increases in proportion to the work done;

and we in consequence find here what has been determined in steam-engines, in which the useful work done is more nearly expressed by the heat lost in the fall of temperature, in proportion as the machines are more perfect.

M. Regnault shows clearly how much his new experiments are opposed to the old hypothesis, which made *caloric* a fluid, at one time in the latent state, at another disengaged and sensible; he shows, on the other hand, how easily they are explained on the theory which attributes heat to a vibratory motion; the principle of the preservation of moving forces then suffices to account for all the transformation of heat into work, and *vice versa*. After insisting upon the fact, that the theory by which Laplace corrected Newton's formula for the velocity of the propagation of sound in air, and explained the considerable differences between the calculated and observed velocities, is no longer admissible, he expresses an ardent desire to see some new series of experiments on the velocity of sound in air, water and solid bodies, taking advantage of all the recent progress of science and the mechanic arts.

ON THE VIBRATION AND TONES PRODUCED BY THE CONTACT OF BODIES HAVING DIFFERENT TEMPERATURES.

The following is an abstract of a paper read before the Royal Institution by Prof. Tyndall, F. R. S. :—

In the year 1805, M. Schwartz, an inspector of one of the smelting works of Saxony, placed a cup-shaped mass of hot silver upon a cold anvil, and was surprised to find that musical tones proceeded from the mass. In the autumn of the same year, Professor Gilbert, of Berlin, visited the smelting works and repeated the experiment. He observed that the sounds were accompanied by a quivering of the hot silver, and that, when the vibrations ceased, the sound ceased also. Professor Gilbert merely stated the facts, and made no attempt to explain them. In the year 1829, Mr. Arthur Trevelyan, being engaged in spreading pitch with a hot plastering iron, and once observing that the iron was too hot for his purpose, he laid it slantingly against a block of lead which chanced to be at hand; a shrill note, which he compared to that of the chanter of the small Northumberland pipes, proceeded from the mass, and, on nearer inspection, he observed that the heated iron was in a state of vibration.

Professor Faraday, after giving the subject some attention, referred them to the tapping of the hot mass against the cold one underneath it, the taps being in many cases sufficiently quick to produce a high musical note. The alternate expansion and contraction of the cold mass at the points where the hot rocker descends upon it, he regarded as the sustaining power of the vibrations. The superiority of lead he ascribed to its great expansibility, combined with its feeble power of conduction, which latter prevented the heat from being quickly diffused through the mass.

Professor Forbes, of Edinburgh, then took up the subject, and rejects

the explanation supported by Professor Faraday, and refers the vibrations to "a new species of mechanical agency in heat"—a repulsion exercised by the heat itself on passing from a good conductor to a bad one. This conclusion is based upon a number of general laws established by Professor Forbes. If these laws be correct, then indeed a great step has been taken towards a knowledge of the intimate nature of heat itself, and this consideration was the lecturer's principal stimulus in resuming the examination of the subject. He had already made some experiments, ignorant that the subject had been further treated by Seebeck until informed of the fact by Professor Magnus, of Berlin. On reading Seebeck's interesting paper, he found that many of the results which it was his intention to seek had been already obtained. The portion of the subject which remained untouched was, however, of sufficient interest to induce him to prosecute his original intention. The general laws of Professor Forbes were submitted in succession to an experimental examination. The first of these laws affirms that "*the vibrations never take place between substances of the same nature.*" This the lecturer found to be generally the case when the hot rocker rested upon a *block*, or on the edge of a thick plate of the same metal; but the case was quite altered when a thin plate of metal was used. Thus, a copper rocker laid upon the edge of a penny-piece did not vibrate permanently; but when the coin was beaten out by a hammer, so as to present a thin sharp edge, constant vibrations were obtained. A silver rocker resting on the edge of a half-crown refused to vibrate permanently; but on the edge of a sixpence continuous vibrations were obtained. An iron rocker on the edge of a dinner knife gave continuous vibrations. A flat brass rocker placed upon the points of two common brass pins, and having its handle suitably supported, gave distinct vibrations. In these experiments, the plates and pins were fixed in a vice, and it was found that, the thinner the plate within its limits of rigidity, the more certain and striking was the effect. Vibrations were thus obtained with iron on iron, copper on copper, brass on brass, zinc on zinc, silver on silver, tin on tin. The list might be extended, but the cases cited are sufficient to show that the proposition above cited cannot be regarded as expressing "a general law." The second general law enunciated by Professor Forbes is, that "*both substances must be metallic.*" This is the law which first attracted the lecturer's attention. During the progress of a kindred inquiry, he had discovered that certain non-metallic bodies are endowed with powers of conduction far higher than has been hitherto supposed, and the thought occurred to him that such bodies might, by suitable treatment, be made to supply the place of metals in the production of vibrations. This anticipation was realized. Rockers of silver, copper and brass, placed upon the natural edge of a prism of rock-crystal, gave distinct tones; on the clean edge of a cube of fluor spar the tones were still more musical; on a mass of rock salt the vibrations were very forcible. There is scarcely a substance, metallic or non-metallic, on which vibrations can be obtained with

greater ease and certainty than on rock salt. In most cases a high temperature is necessary to the production of the tones; but in the case of rock salt, the temperature need not exceed that of the blood. A new and singular property is thus found to belong to this already remarkable substance. It is needless to enter into a full statement regarding the various minerals submitted to experiment. Upwards of twenty non-metallic substances had been examined by the lecturer, and distinct vibrations obtained with every one of them. The number of exceptions here exhibited far exceeds that of the substances which are mentioned in the paper of Professor Forbes, and are, it was imagined, sufficient to show that the second general law is untenable. The third general law states, that "The vibrations take place with an intensity proportional (within certain limits) to the difference of the conducting powers of the metals for heat, the metal having the least conducting power being necessarily the coldest." The evidence adduced against the first law appears to destroy this one also; for if the intensity of the vibrations be proportional to the difference of the conducting powers, then, where there is no such difference, there ought to be no vibrations. But it has been proved, in half a dozen cases, that vibrations occur between different pieces of the same metal. The condition stated by Professor Forbes was, however, reversed. Silver stands at the head of conductors; a strip of the metal was fixed in a vice, and hot rockers of brass, copper and iron, were successively laid upon its edge; distinct vibrations were obtained with all of them. Vibrations were also obtained with a brass rocker, which rested on the edge of a half sovereign. These and other experiments show that it is not necessary that the worst conductor should be the cold metal, as affirmed in the third general law above quoted. Among the metals, antimony and bismuth were found perfectly inert by Professor Forbes; the lecturer, however, had obtained musical tones from both of these substances. The superiority of lead as a cold block, Professor Faraday, as already stated, referred to its high expansibility, combined with its deficient conducting power. Against this notion, which he considers to be "an obvious oversight," Professor Forbes contends in an ingenious and apparently unanswerable manner. The vibrations, he urges, depend upon the difference of temperature existing between the rocker and the block; if the latter be a bad conductor and retain the heat at its surface, the tendency is to bring both the surfaces in contact to the same temperature, and thus to stop the vibration instead of exalting it. Further, the greater the quantity of heat transmitted from the rocker to the block during contact, the greater must be the expansion; and hence, if the vibrations be due to this cause, the effect must be a maximum when the block is the best conductor possible. But Professor Forbes, in this argument, seems to have used the term expansion in two different senses. The expansion which produces the vibration is the sudden upheaval of the point where the hot rocker comes in contact with the cold mass underneath; but the expansion due to good conduction would be an expansion of the general mass. Imagine the

conductive power of the block to be infinite, that is to say, that the heat imparted by the rocker is instantly diffused equally throughout the block; then, though the general expansion might be very great, the local expansion at the point of contact would be wanting, and no vibrations would be possible. The inevitable consequence of good conduction is, to cause a sudden abstraction of the heat from the point of contact of the rocker with the substance underneath; and this the lecturer conceived to be the precise reason why Professor Forbes had failed to obtain vibrations when the cold metal was a good conductor. He made use of *blocks*, and the abstraction of heat from the place of contact by the circumjacent mass of metal was so sudden as to extinguish the local elevation on which the vibrations depend. In the experiments described by the lecturer, this abstraction was to a great extent avoided by reducing the metallic masses to thin laminæ; and thus the very experiments adduced by Professor Forbes against the theory supported by Professor Faraday appear, when duly considered, to be converted into strong corroborative proofs of the correctness of the views of the philosopher last mentioned.

ON THE EFFECT OF PRESSURE ON THE TEMPERATURE OF FUSION OF DIFFERENT SUBSTANCES.

Mr. Hopkins, before the British Association, in a paper on the above subject, described the apparatus he had used, and the successive steps by which fusion in some contrivances had led him to that which was ultimately found to answer. In particular, how, from the enormous pressures to which the substances were subjected, they found it impossible to use glass to see what was going on within the cylinders in which the substance to be experimented upon was enclosed; which difficulty had been got over by causing an iron ball to rest on the top of the substance within the cylinder, while its presence deflected a small magnetic needle outside; but the instant the melting of the substance inside permits the ball to fall, the magnetic needle returning to its position of rest indicated the fact. The use of this needle made it necessary to make the cylinder of brass; and Mr. Hopkins stated that, with the first cylinder they used, they were surprised to find when enormous pressures were laid on that the liquid within wasted; the cause of this they long sought to discover in vain, until at length they found that it was escaping through the very pores of the metal in thousands upon thousands of jets so minute as to be almost imperceptible. This they remedied by greater care in the casting of the cylinder, and hammering it well on the outside. The method of laying on the pressure was by a piston well packed aud forced down by a lever. This they adopted as the simplest means of getting a numerical estimate of the actual compressing force. Mr. Hopkins then described the method by which the friction had been determined which opposed the motion of the piston, and so diminished the pressure by so much. This was done by noting the weight required to drive the piston in a certain small distance: this, less by

the friction, was equal to the compressing force; then noting the weight which allowed the piston to return exactly to its first position: this, together with the friction, is equal to the compressing force; but, as these two compressing forces are equal, the friction is equal to half the difference of the two weights used, and is then a matter of very simple calculation. Mr. Hopkins then gave the results of the experiments, of which the following are the most important:—

Substances experimented upon.	Pressure in lbs. to the Square Inch.			Temperature Fahrenheit at which it liquefied.		
Spermaceti . . .	0	7,790	11,880	124°	140°	176.5°
Wax	0	7,790	11,880	148.5	166 5	176.5
Sulphur	0	7,790	11,880	225	275.5	285
Stearine	0	7,790	11,880	158	155	165

Of course, when the weight 0 was on the piston, the substance was under atmospheric pressure, or about 15 lb. to the square inch; and the pressure of 7,790 lb. per square inch was just that at which the Britannia Bridge had been raised. Mr. Hopkins had also tried the metallic alloys which fuse at low temperatures, but had not detected any elevation of fusing temperature required by increasing the pressure; but these experiments required to be repeated and confirmed before they could be relied upon.

A paper was also read in this connection by Mr. Fairbairn,—"On the Solidification of Bodies under Great Pressure,"—which contained the results of a portion of the experiments conducted by himself, Mr. Hopkins and Mr. Joule, at the request of the Association, and by means of funds supplied for that purpose by the Royal Society. At the last meeting at Hull, Mr. Hopkins alluded to these experiments, and then explained the nature of the apparatus invented by Mr. Fairbairn for submitting the substances to be operated on to the enormous pressure of 90,000 lb. on the square inch. In these inquiries the objects kept in view were, to ascertain the exact laws which govern the cohesive strength of bodies in their present physical condition, and how far a knowledge of those laws may conduce to the reduction of the metals, and their subsequent solidification under circumstances whereby increased strength and density may be obtained. The experiments commenced with spermaceti, bars of which were cast and left to solidify at the same temperature, but under different pressures. When pressure was applied to these bars, the one that sustained a pressure of 40,793 lb. carried 7.52 lb. per square inch more weight than one submitted to a pressure of 6,421 lb., the ratio being in favor of the more strongly compressed bar, in its power of resistance to a tensile strain, as 1 to .876. It appeared from these experiments that bodies when solidified under pressure have not only their densities greatly increased, but their molecular structure is also materially affected, so as to increase

their adhesive power. Still further to elucidate the subject, cubes of exactly one inch were carefully prepared and loaded with weights till they were crushed. The first cube, solidified under a pressure of 6,421 lb., was crushed with 213 lb. Tin was then operated on, a quantity of pure tin being melted and then allowed to solidify, first at the pressure of the atmosphere, and afterwards at a pressure of 908 lb. on the square inch. The same quantity taken from the same ingot was subsequently submitted to a pressure of 5,698 lb. on the square inch. The bars, after being solidified and allowed to cool for upwards of fourteen hours, were subjected to the usual tests of tensile strains. From these experiments there was derived, as nearly as possible, the same law or measure of strength in regard to the effects of pressure as obtained from the experiments on spermaceti; for, with the same pressures of 908 lb. and 5,698 lb. upon the square inch, the breaking weights were 4,053 lb. and 5,737 lb., or in the ratio of 1 to .706, being an increase of nearly one-third on the crystallized metal when solidified under about six times the pressure. From these facts, Mr. Fairbairn observed, it is evident that the power of bodies to resist strain is greatly increased when solidified under pressure; and he said he considered it highly probable that the time is not far distant when the resisting powers of metals, as well as their densities, may be increased to such an extent as to insure not only greater security, but greater economy by solidification under pressure. He said he was borne out in these views by the fact that the specific gravities of the bodies experimented on were increased in a given ratio to the pressure. Spermaceti solidified under a pressure of 908 lb. on the square inch, had a specific gravity of 0.94859; whilst that solidified under a pressure of 5,698 lb. had its specific gravity increased to 0.95495. The specific gravity of tin solidified under a pressure of 908 lb. was 7.3063; and that solidified under a pressure of 5,698 lb. was 7.3154, which gave .0091 as the increased density from pressure. There are further experiments in progress to determine the law that governs this increase of specific gravity, and to determine the conducting powers of bodies solidified under severe pressure. Experiments have also been made on such substances as clay, charcoal and different kinds of timber. From the experiments on powdered dry clay, it appeared that a bar of that substance 3½ inches long and 1¼ inches diameter, after being hammered into the cylinder so as to become slightly consolidated, was reduced in bulk with a pressure of 9,940 lb. on the square inch to 2.958; with a pressure of 54,580 lb. to 2.3; with 76,084 lb. to 2.288; and with a pressure of 97,588 lb. to 2.195 inches.

INVESTIGATION INTO THE THEORY OF THE PENDULUM.

An important investigation of the theory of the pendulum, taking into account the rotation of the earth, has recently been published by the Physical Society of Dantzic, being a memoir on the subject by M. Hansen, which has been honored with the prize of the Society. The

chief novelty of the investigation consists in introducing the supposition of the pendulum being, not a mere mathematical point, but a physical agglomeration of particles. By adopting this more general view of the subject, M. Hansen has succeeded in deducing several results of a hidden character which had hitherto escaped notice. The most important of these consists in the fact, that a rotatory motion of the pendulum about its axis is capable of exercising a very sensible influence on the azimuthal motion of the plane of oscillation. M. Hansen illustrates his results by a variety of striking examples, and he concludes his valuable essay by investigating the motion of a pendulum of a novel construction invented by himself, with the view of obviating certain disadvantages attending the usual form.

INTERESTING EXPERIMENTS WITH THE PENDULUM.

A series of interesting experiments with the pendulum have been recently made by Prof. Airy, the Astronomer Royal of England, assisted by a number of eminent astronomers, in a pit of Harton colliery, South Shields, 1,260 feet deep. The observations consist in noting the vibrations of an invariable pendulum on the surface, and another at the bottom of the mine, both being mounted on firm iron stands, in a manner similarly to each other. These pendulums hang on knife-edges, resting on agate planes, thus sustaining little resistance from friction. If swung *in vacuo*, the vibrations would probably continue for 24 hours, and in their state as used, though liable to hinderance from atmospheric causes, yet the vibrations will continue at least eight or nine hours. Corrections are applied to the results for the effect of temperature, and also for buoyancy, or the effect produced by the pressure of the air on the pendulum. The vibrations are counted by the assistance of a clock, which is mounted immediately behind the detached pendulum; and thus, by the aid of the clock, the number of vibrations in a certain time can be easily noted. To the centre of the bob of the clock pendulum is attached a small oval-shaped disk, covered with gold-leaf, and illuminated by a lamp. It is necessary in the adjustments that this disk, when stationary, should be hid by the detached pendulum, and that there should be a slit in the clock-case, which should also be just covered by it. A line, therefore, drawn through the centre of the telescope which is placed at a little distance, through the detached pendulum, the slit in the clock-case, and the illuminated disk on the clock pendulum, should be a straight line. Suppose the two pendulums set swinging, we should soon perceive that one was vibrating faster than the other, and that the disk would be gradually approaching the detached pendulum until it would be completely hid, and both pendulums would be going exactly together. This is called a coincidence, and is carefully noted to the nearest second of time. When the illuminated disk has reappeared, which is generally in a few seconds, one pendulum will still continue gaining on the other until another coincidence takes place. The time is again noted; and thus we have the interval of coincidence, or

the time occupied in one pendulum gaining two seconds over the other. The rate of one pendulum over the other is easily found; and as this operation is performed simultaneously at the upper and lower stations, nothing remains but the comparison of the two clocks. In the Astronomer Royal's former experiments in Cornwall, this was the most difficult part of the operation. At that time it was necessary to fasten the chronometers to the body by means of straps, and then to ascend or descend by perpendicular ladders—a journey which occupied considerably more than an hour in its accomplishment. In the present experiments this section of the observations is quite as satisfactory as, if not more than, the observation of coincidences. This is owing to the adaptation of galvanism to astronomical purposes, and by this means the comparison of the clocks is effected. A wire, properly coated with gutta-percha, passes from one pole of the battery through a clock, which is so arranged as to push a spring, causing a galvanic circuit every fifteen seconds. From the clock the wire passes through a galvanometer attached to the clock-case at the upper station, thence underground to the shaft, down which it descends to the lower station, where it passes through another galvanometer, also attached to the lower clock-case. It then returns up the shaft to the other pole of the battery, and thus the circuit is completed. Signals were simultaneously noticed by the observers at the upper and lower stations, which give a direct comparison of the two clocks.

FOUCAULT'S EXPERIMENTS.

At the recent meeting of the British Association, M. Foucault, the well-known author of the experiment for demonstrating the rotation of the earth, and the inventor of the gyroscope, exhibited a series of experiments, which are thus described in the record of the proceedings :—

The gyroscope is a massive ring of brass connected with a steel axis by a thinner plate of the same metal, all turned beautifully smooth, and most accurately centred and balanced; in other words, the axis caused to pass accurately through the centre of gravity, and to stand truly perpendicular to the plane of rotation of the entire mass. On this axis was a small but stout pinion, which served when the instrument was placed firmly on a small frame, containing a train of stout clock-work, turned by a handle like a jack, to give it an exceedingly rapid rotatory motion on its axis. But to this clock-work frame it could be attached or detached from it instantly. This revolving mass was only about three inches wide, and four of them were mounted in frames a little differently. The first was mounted in a ring, attached to a hollow sheath, which only permitted the axle and the pinion to appear on the outside, so that it could be laid hold of, or grasped firmly in the hand, if the pinion were not touched, while the mass inside was rapidly revolving without disturbing that motion. By this modification of the gyroscope, the author afforded to the audience a sensible proof of the determination with which a revolving mass endeavors to maintain its own axis of permanent stable rotation; for upon setting

it into rapid rotatory motion, and handing it round the room, each person that held it found himself forcibly resisted in any attempt to turn it round either in his fingers, to the right hand or left, or up or down, or in his hands if he swung it round. So that the idea was irresistibly suggested to the mind, that there was something living within which had a will of its own, and which always opposed your will to change its position. The second modification presented the mass suspended in a stout ring, which was furnished with projecting axles, like the ring of the gymbal. These axles could be placed in a small frame of wood bushed with brass. This small frame, when placed on a piece of smooth board, could be turned freely round by turning the piece of board on which it rested as long as the gyroscope was not revolving, friction being sufficient to cause the one to turn with the other; but, when the gyroscope was set rapidly revolving, in vain you attempted to turn the frame by turning the board on which it rested, so determinately did it endeavor to maintain its own plane of rotation as quite to overpower the friction. In the third modification of the gyroscope it was suspended in gymbals, so exquisitely constructed that both the gyroscope proper and the supporting gymbals were accurately balanced, so as to rest freely when placed in any position in relation to the earth. By this the author showed most strikingly the effect of any attempt to communicate revolving motion round any other axis to a mass already revolving; for, on placing the gymbals in a frame of wood while the gyroscope was not revolving, it remained quite steady; but, when thrown into rapid revolving motion, the slightest attempt to turn the frame round to the right or to the left was instantly followed by the entire gyroscope turning round in the gymbals, so as to bring its axis to coincide with the new axis you endeavored to give it with a life-like precision, and always so as to make its own direction of revolution be the same as that of the slightest turn you impart to it. Having thus demonstrated the necessary effect of combining one rotatary motion with another, he then proceeded to demonstrate palpably that the earth's revolving motion affected the gyroscope in precisely a similar way. Having, by the screw adjustments, brought the gyroscope, in gymbals, to a very exact balance, it remained fixed in any position when not revolving. But, rapid rotatory motion having been communicated to the gyroscope mass as soon as the gymbal supports are placed on the stand, you see the entire apparatus, slowly at first, but at length more rapidly, turn itself round, nor ever settle until the axis, on which the gyroscope is revolving, arranges itself parallel to the terrestrial axis, in such a sense as to make the direction of the revolving gyroscope be the same as that of the whole earth. He next showed that the determination with which it did this was sufficient to control the entire weight of the instrument, though that amounted to several pounds; for, taking the ring gyroscope from the side of the ring of which a small steel wire projected, ending in a hook, the wire coincided with the prolongation of the axis of the gyroscope: of course, when not made to revolve, the hook, if placed in a little agate cup at the top of a stand, would permit the instrument, by its weight, to fall instantly, as soon as the support of

the hand was taken from it. But, upon imparting to it rapid rotatory motion, it stood up even beyond the horizontal position, so as to bring its axis of rotation nearly to the same inclination to the horizon as the axis of the earth, while the whole acquired a slow rotatory motion round the point of the hook; and so steady was its equilibrium while moving thus, that a string being passed under the hook, and both ends brought together in the hand, the whole may be lifted by the cord off the stand and carried revolving steadily about the room. Next, to show the motion of the earth sensibly, he placed the gymbal gyroscope, suspended freely by a fine silk fibre, in a stand, with the lower steel point of its support resting in an agate cup; a long light pointer projecting from the ring carried a pointed card, which passed over a graduated card arch of a circle placed concentrically with the gyroscope; upon imparting rapid rotatory motion to the gyroscope, the index was seen as the earth moved to point out the relative motion of the plane of rotation exactly in the same way: the law of the motion being also the same as that of the well-known pendulum experiment. Lastly, he set the ring gyroscope in motion, and by placing a small pointed piece of brass at the end of the axle on the ring, the instrument went immediately through all the evolutions of a boy's top on the floor, humming meanwhile loudly also.

These beautiful and most decisive experiments were received most enthusiastically.

ON CERTAIN PHENOMENA OF ROTATORY MOTION.

The following is an abstract of a lecture delivered before the Royal Institution, London, by Professor Baden Powell, on the above subject, which has excited considerable attention, on account of the novelty and interest of the views and experiments alluded to. The mechanical principle of "the composition of Rotatory Motion," originally discovered by Frisi about 1750, is equally simple in its nature, important and fertile in its consequences and applications, and susceptible of the easiest explanation and experimental illustration; yet it has been singularly lost sight of in the common elementary treatises. The principle is involved in the explanation of several important phenomena, some of which are in fact mere direct instances of it, so that a simple experimental mode of exhibiting it would be eminently desirable; and several such have accordingly been devised, which yet seem to have been but little generally known. Such an apparatus, designed for lecture illustration, had been constructed by the author, the object of which was to show experimentally, without the use of complex and delicate machinery, the actual composition of rotations about two different axes impressed at once on the same body. The essential parts are merely a bar capable of rotating freely about one end of an axis, (and loaded at its extremities to keep up the rotation,) while the axis itself can turn about a point in its length, near the end carrying the bar, upon a horizontal axis, capable of moving freely round a

vertical pillar. At the lower end of the first axis is a weight which more than counterpoises the upper part. If, then, there be no rotation in the bar about the first axis, the effect of the weight is to produce a rotation about the second alone, bringing down the first axis into a vertical position. If now the first axis be held horizontally or obliquely, and a rotatory motion be given to the bar about it, on letting the axis go, we compound both rotations; and the resulting effect is, that the weight will no longer bring the axis down, or alter its inclination at all, but will cause it to take a new position, or make the whole turn round the vertical, in a direction opposite to that of the rotation. Thus, although confessedly not new in principle, to make public an experimental illustration in so simple a form may not be without its use for a great majority of students. Even the theoretical principle is capable of being stated in a way quite intelligible to those acquainted only with the very first rudiments of theoretical mechanics, presenting itself in close analogy to that well-known first principle, the composition of rectilinear motion. As in this last case, if a body be in motion in one direction, and any cause tends to make it move in another, it will move in neither, but in an intermediate direction,—so we have the strictly analogous case in rotatory motion; when a body is rotating about an axis, and any cause tends to make it rotate about another axis, it will not rotate about either, but about a new axis intermediate to the two. Thus the result of compounding the two rotations will be that the axis (carrying with it the rotating body) will simply take a new position, or will move in a direction determined by the nature of the impressed motions. Professor Magnus, in an able, but rather prolix and obscurely-written memoir, speaks of the consequences of such a law as evinced in the resulting rotations, but without any distinct or explicit statement of the essential theorem of the composition of rotatory motion. He gives, however, some singular and even paradoxical exemplifications of it. We may allude to one of these, which is capable of being put into a form at once more simple, and at the same time more paradoxical, than that in which he describes it. It consists in this: a wheel at one end of an axis, and a weight at the other, are suspended in equilibrio; which is, of course, unaltered, whether the wheel be at rest or in rotation: the weight is then slid so that the balance is destroyed: now, if the wheel be set in rapid rotation, the equilibrium is restored. This is nothing but a simple case of the principle just stated, as shown by the author's apparatus. Besides certain other cases traceable to a different cause, Professor Magnus's immediate object is to explain a curious observed anomaly in the motion of projectiles of an elongated form shot from rifled guns, and which consequently rotate about their axis while passing through the air in the direction of that axis. He mentions the fact that artillery experiments in different countries, with rifled cannon and missiles of a cylindrical form with a conical apex, always show a deviation of the point of the missile to the right, the rifle-spiral being right-handed. To explain the nature of this deviation was the object of special experiments on

the part of the Prussian Artillery Commission, in which Prof. Magnus assisted. The missiles were fired with low charges, so as to allow the motion to be accurately observed, and it was found that the axis remained sensibly in the direction of the tangent to the curved path, while the deviation to the right was always clearly marked. He observes that left-handed rifles have never been tried. Prof. Magnus, after some fruitless conjectures as to the cause, at length sought it in the principle of the composition of rotatory motion. He tried experimentally the effect of a current of air on a projectile of the form employed, by inserting such a body instead of the rotating sphere in Bonenberger's apparatus, and observing the effect on it, first at rest, and then in rotation, when the strong current of a blowing machine was directed against the conical apex. When at rest, the current elevated the apex, owing to the form of the missile, the resistance acting not through the centre of gravity, but above it: when in rotation no elevation took place, but a deviation in the direction of the axis, in a direction opposite to that of rotation. To show the application of the principle in this case, he observes that the axis of the elongated projectile, which for an instant coincides with the tangent to its curved path, momentarily changes its direction, so that the front extremity or apex falls below its former position. Or, for a single instant, it may be regarded as if locally at rest, but turning about its centre of gravity so as to depress the apex. If the motion were simply in the direction of the axis, the resistance of the air would operate directly against it; but when the apex is continually tending to turn downwards from that line, the resistance acts against it partially upwards, and thus tends to raise the apex. Thus, at a given instant, the elongated projectile may be represented by the rotating part of the apparatus just described. When there is no rotation, the resistance of the air tending to raise the apex is represented by the weight at the lower end, which produces the same effect. When a rapid rotation is communicated, (suppose from left to right of the gunner,) the result will be, no elevation of the apex, but a lateral movement, or commencement of a rotation round the vertical,—in astronomical language retrograde, if the former rotation be direct,—but which, beginning from the opposite part of the circle, is, relative to the operator, towards the right. The form of the projectile used in these experiments differs from that in the Minié rifle, in that the latter is hollow at its broader end, and thus the centre of gravity is thrown forward towards the apex. Hence, according to the same theory, the effect would probably here be to depress the apex, and therefore to give an opposite deviation: but it does not appear whether any such observations have been made; and in practice the effect would probably be quite insensible. It occurred to the author that a very simple illustration of this deviation of rifle projectiles might be made by merely forming a sort of small arrow, whose head was composed of a cork, like a shuttle-cock, but, instead of the feathers, small card vanes inclined in the same direction round it, with a tail to balance it, and which thus, in the mere act of throwing, acquires a rotatory motion

from the reaction of the air, to the right or left, according as the vanes are inclined; and on trying this there was always observed a deviation in the direction of the axis or point of the missile to the right or left accordingly, relative to the experimenter. It is in fact nearly impossible to throw such a body in a direction perfectly in one plane. The true deviation is, however, peculiarly liable to be disguised by the general resistance of the air on so light a missile, as well as by currents, &c., which it is not easy to guard against. The well-known case of the boomerang exhibits effects closely similar; for it is found that, if so projected that its rotation is from left to right, its deviation will be in the same direction, and *vice versa;* that is, supposing (as is the usual case) that its plane is inclined upwards from the operator:—if it be inclined downwards, the deviation is in the direction opposite to that of the rotation. In the former case, the reaction of the air against the flat surface of the missile would tend to increase its inclination upwards, in the latter downwards, with respect to the operator; and this in each case respectively would give the motion stated, as is easily seen on the principle and by means of the apparatus before described. Thus it would follow that this extraordinary instance of savage invention, which long ago puzzled inquirers, is simply a case (like the last) of "the composition of rotatory motion." It should, however, be mentioned that some experimentalists have entertained a different view of the cause of deviation in this instance. From these singular applications of a very simple mechanical truth, we may now turn to what is but another exemplification of the same thing, however apparently remote from those we have considered, and upon a far grander scale. The phenomenon of the Precession of Equinoxes was known to Hipparchus; but no explanation of the fact was for ages imagined. Even Kepler, in the multiplicity of his hypothetical resources, could not succeed in devising any thing plausible. The axis of the earth is slowly shifting its position, so that its pole points continually to a new part of the heavens,—a new polestar,—at the rate of about 50″ a year, and of course carries with it the point of intersection of the earth's equator with the ecliptic or plane of its orbit at the same rate and in a direction opposite to that of its motion or the order of the signs. These phenomena remained wholly without explanation till Newton, led by the analogy of those disturbing forces on the orbit of a planet which cause its nodes to regress, showed that the same would occur in a satellite to the earth,—in a ring of such satellites,—in such a ring adhering to the equator, or the protuberant part of the terrestrial sphere; and thus that the equinoctial points would slowly regress. The more exact determination of quantitative results was reserved for Newton's successors, when a more powerful analysis had been applied by Euler, D'Alembert, and others, to the full exposition of the theory, founded on general equations of motion.

These higher mathematical views, though of course the most complete and systematic, are not the most direct or easy mode of explaining the subject to the student. Greater simplicity certainly characterizes the

method adopted by Mr. Airy, of applying directly the theorem of the composition of rotary motion; as doubtless Newton would have done, had it been known to him. But here, as in so many other instances, the first explanation presented itself mixed up with more complex considerations; and, as has been well observed, "simplicity is not always a fruit of the first growth." To those not versed in the mathematical theory, of all points in Physical Astronomy, the *modus operandi* of the Precession, perhaps, usually seems the most paradoxical, and the explanations given in some of the best popular treatises are seldom found satisfactory, following as they do the letter of Newton's illustration, and omitting the direct introduction of the principle of composition, which, if only from what has been here offered, is at once seen to be easily capable of the most elementary explanation. Indeed, it was from this consideration, forcing itself on the mind of the author in several courses of popular lectures on Astronomy, that he was led to seek the means of experimental illustration above described, and which would more palpably imitate the phenomena to the eye, if, instead of the rotating bar, a terrestrial globe be substituted,—for better illustration made protuberant at the equator,—where the weight at the south pole acts the part of the sun's and moon's attraction, to pull down the protuberant matter of the spheroid at the equator if at rest, but when combined with the earth's rotation results in a transferrence of the position of its axis, or slow revolution of its pole round the pole of the ecliptic in a direction opposite to its rotation, carrying with it the equinoctial points, and causing the signs of the zodiac to shift backwards from their respective constellations. It always affords a sort of intellectual surprise to perceive for the first time the application of some simple and familiar mechanical principle to the grand phenomena of astronomy; to see that it is but one and the same set of laws which governs the motions of matter on the earth and in the most distant regions of the heavens; to find the revolution of the apsides in a pendulum vibrating in ellipses, or the conservation of areas in a ball whirled round by a string suddenly shortened; or (as in the present case) to perceive a celestial phenomenon, vast in its relations both to time and space, and complex in its conditions, identified, as to its mechanical cause, with the rotatory movement of a little apparatus on the table before us; or to discover the Precession of Equinoxes in the deviation of a rifle or a boomerang. And the simple experimental elucidation of such phenomena and their laws will not be useless, as it tends to confirm in the mind of the student the great characteristic of the modern physical philosophy first asserted by Galileo, the identity of the causes of the celestial and terrestrial motions, and to aid and elevate our conception of those grand and simple principles according to which the whole machinery of the universe is so profoundly adjusted.

TABLE TURNINGS.

Much interest has been excited in Paris by a paper of M. Chevreul's to the Academy of Sciences, taken from the introduction of a work now in press, in which he treats of the phenomena of table turnings. This distinguished chemist does not confine himself to this subject alone, but connects with it the "exploring pendulum" and "divining rod," and he endeavors to reduce these phenomena to certain rational facts. In 1812, he noted the phenomena of the pendulum in a letter to Ampère, and showed that the pendulum movement was produced only when the eye of the experimenter was fixed on the instrument; and he endeavored to prove thereby that the motion was due to a play of the muscles. Some members of the French Academy objected to the consideration of a subject connected to such an extent with supersitition. M. Chevreul believes that the question may be treated without going out of the domain of true science, agreeing with Arago and Faraday, and regards it not unworthy of a man of true science to occupy himself with any demonstrated facts in order to search out their relation to other facts.

DEFINITION OF THE BOILING POINT OF WATER.

The following report was made at the last meeting of the British Association by the "Kew Committee:"—

"Your Committee, at the last meeting of the Association, were requested to furnish a report on the definition of the boiling point of water as at present adopted in this country for the thermometric scale. This has already been considered by the Commissioners appointed by Government to construct standard weights and measures; and in the report they have presented to Government during the present year, they have defined 212° upon Fahrenheit's scale to represent 'the temperature of steam under Laplace's standard atmospheric pressure, or the atmospheric pressure corresponding to the following number of inches in the barometric reading, reduced to 32° F.,—29.9218 + 0.0766 × cosine (2 latitude) + (0.00000179 × height in feet above the sea.') Your Committee recommend that this definition be adopted."

CHEAP MICROSCOPE.

There is a man who sometimes stands in Leicester Square, London, who sells microscopes at one penny each. They are made of a common pill-box; the bottom taken out, and a piece of window glass substituted; a small hole is bored in the lid, and therein is placed a lens, the whole apparatus being painted black. Upon looking through one of these microscopes, I was surprised to find hundreds of creatures, apparently the size of earthworms, swimming about in all directions; yet on the object

glass nothing could be seen but the small speck of flour and water, conveyed there on the end of a lucifer match, from a common inkstand, which was nearly full of this vivified paste. I bought several of these microscopes, determined to find out how all this could be done for a penny. An eminent microscopist examined them, and found that the magnifying power was 20 diameter. The cost of a lens made of glass of such power would be from 3*s* to 4*s*. How, then, could the whole apparatus be made for a penny? A penknife revealed the mystery. The pill-box was cut in two, and then it appeared that the lens was made of Canada balsam, a transparent gum. The balsam had been very cleverly dropped into the eye-hole of the pill-box. It then assumed the proper size and transparency of a well-ground lens. Our ingenious lens maker informed me that he had been selling these microscopes for fifteen years, and that he and his family conjointly made them. One child cut the pill-box, another the cap, another put them together, his wife painted them black, and he made the lens.—*Dickens's Household Words.*

NEW REFRACTOMETER.

This instrument, invented by Prof. Bernard, and exhibited to the British Association, was founded on the principle of passing a ray of light through a medium bounded by two parallel surfaces, and might be called the refractometer of separation. When a ray passes through such surfaces, if it be incident perpendicularly, it emerges in the same course. If it be incident obliquely, its emergent course is parallel to that of its incidence. Then the relations which connect the perpendicular distance between the incident and emergent rays—the angle of incidence—the thickness of the medium or distance between the surfaces bounding it, the index of refraction is known; the first two can be observed, the third measured; and then the fourth, which is what we seek, is a matter of simple calculation.

Dr. Whewell expressed the pleasure he experienced at seeing this very beautiful instrument, and was particularly struck with the clear proof arrived at by Prof. Bernard, that the light at the several parts of the solar spectrum was simple, and not compounded light; and that thus the view which had been some years since propounded, and which was still entertained by some, that the spectrum obtained by the prism was composed of several superimposed spectra, is proved to be unfounded, and must be abandoned.

ON SOME STEREOSCOPIC PHENOMENA.

Mr. Dove, at the British Association, stated that he was chiefly induced to draw the attention of the Section to this subject in consequence of Sir David Brewster having denied at the Belfast Meeting the soundness of the explanation which the author had given of the cause of the appearance of those bodies which exhibited the metallic lustre. This he considered to

arise from the superficial layers of particles being highly, though still imperfectly, transparent, and permitting the inferior layers to be seen through them. This effect we see produced when many watch-glasses are laid in a heap, or when a plate of transparent mica or talc being heated red hot is thus separated into multitudes of thin layers, each of which, of inconceivable thinness, is found to be highly transparent, while the entire plate assumes the lustre of a plate of silver. This explanation receives a very striking confirmation from the stereoscopic phenomena which he now drew attention to. He then presented to the Section and described a very simple and portable modification of the stereoscope, consisting of two lenticular prisms mounted in a frame like a double eye-glass. Upon examining with this two diagrams drawn, one for the right, the other for the left eye, with lines suited to give the idea when viewed together of a pyramid, cube, cone, or other mathematical solid, but the lines on one drawn on a white ground, the other on a dark or colored ground, on viewing them together the solid appeared with the metallic lustre. The author termed it "Glance." This, he conceived, demonstrated his original idea to be correct.

ON IRRADIATION.

Prof. W. B. Rogers, in a paper read before the American Scientific Association, divides the phenomena of irradiation into two distinct kinds. When the sun glances from the surface of a polished steel ball, or when we observe any brilliant light near the eye, the centre of illumination is surrounded by a circle of rays, which are not stationary, but seem to have a pulsatory motion, and the pupil of the eye contracts to protect it. This is radiation of one sort. The second sort we see on observing lights at a distance, as the stars; or lights which are only bright comparatively, being set on a dark back-ground. The radiation of such lights is not circular, nor uniform. Different eyes give different patterns. The first may depend on the fact that the rays pass through the edge of the iris, which are drawn together when the pupil contracts, as it always does, to shut out the intense light; and the second form upon the irregularities of the edge of the iris, which in no two individuals or eyes has precisely the same outline.

DIOPTRIC REFRACTORS.

It is well known to those who are acquainted with the principles of optical science, that when light passes from one medium to another in any direction not perpendicular to the surface dividing them, that direction undergoes a sudden change, called refraction; the amount of this change of direction, or divergence, is dependent on the angle of incidence, as it is called. To take advantage of this principle in utilizing to the utmost extent the light derivable from gas and other burners, of the description in every-day use, the dioptric refractor has been invented by Messrs Boygett

and Pettit of England. This instrument consists of a glass ring of a prismatic section placed so as to surround the flame at such a height that all the lateral rays of light proceeding from it are intercepted by the ring, and, falling on its inclined exterior surface, are projected downwards and concentrated within the range of the refractor. This range will depend on the angles to the interior and exterior surfaces of the prismatic ring, and can evidently be increased or diminished by making the angles between the sides and the base of the prism greater or less. The effect produced by the arrangement is such as could not fail to excite the attention of even the most cursory observer. It is not indeed under all circumstances that it is desirable so to concentrate the light; but for all show purposes, and to enable delicate mechanical or other operations to be performed with artificial light, this is absolutely necessary, and there is no contrivance by which this can be done so effectually as by the present.—*London Mechanics' Magazine.*

STANDARD BAROMETERS.

The "Kew Committee" of the British Association, having been requested by Lieut. Maury to give their advice respecting the best form of a marine barometer, reported at the last meeting that they had taken the subject into consideration, and, after examining several instruments, had selected one, in which it is believed all the requisites for making correct observations at sea will be found to have been obtained at a very moderate cost, combining convenience and accuracy in observing with simplicity and durability in its general construction.

The great importance as to certain conditions requisite in a good barometer induced the Committee to have the action of this instrument tested by such means as were at their command, and this was effected by Mr. Welsh (accompanied by Mr. Adie, the maker) in a voyage to Leith and back to London; subsequently the action of the instrument was further tested by Mr. Welsh in a voyage to and from the Channel Islands.

[The results of these experiments are detailed in a letter from Mr. Welsh, included in the report.] Mr. Welsh says:—

"1st. Any one of the three barometers is capable of showing *at sea* the changes of pressure, with a probable error of about 0.005 inch, or at most 0.007 inch.

2d. The tremor of a steamship is rather beneficial than otherwise to the performance of the barometer, and (leaving the pumping out of consideration) the barometer performs rather better at sea than on land.

3d. For such a motion of the ship as must be very common, the amount of contraction of the tube should be greater than in any of the three barometers employed, say a contraction to 18 or 20 minutes. The *mean* amount of pumping from ten observations in the return voyage was, for the tube contracted to 5 minutes, 0.064 inch, and for the one contracted to 10 minutes, 0.031 inch; the greatest observed being for the former,

0.13 inch, and for the latter, 0.05 inch. In order, therefore, to reduce the pumping, so that the probable error of an observation from this cause may not exceed 0.01 inch, the contraction should be to 20 minutes at least.

4th. It appears to be very desirable that each ship should be furnished with *two* barometers—one for calmer weather and the other for rougher—the former having the tube contracted to 10 or 12 minutes, and the latter to about 25 minutes. This would render good observation obtainable in all states of the weather; and if occasional comparisons of the two were taken, would, besides obviating to some extent the inconvenience arising from an accident to one, afford the means of checking any changes which might occur in the zero points of either instrument. If, however, two barometers cannot be supplied to each ship, I am disposed at present to think that a contraction to about 15 or 20 minutes would be generally the most convenient."

ON THE CARTESIAN BAROMETER.

The following remarks on the Cartesian Barometer were recently made before the Royal Institution, England, by Dr. Roxburgh :—

Soon after the discovery of the variations in the height of the barometer, Descartes proposed the following mode of rendering them more conspicuous, almost as much so as they are in one filled with water alone. He suggested that two tubes should be joined to the opposite ends of a short, wide cylinder, so as to form one straight tube, which, being closed at one end, was to be filled with pure water and mercury in such proportions as to allow of the two fluids at all pressures meeting in the cylinder. In this, the Cartesian barometer, the pressure of the atmosphere is balanced by the water and mercury conjointly: but the variations of pressure are indicated chiefly by movements of the water, as the level of the mercury varies little in consequence of the large area of the cylinder. The movements of the water and mercury are to each other inversely as the areas of the tube and cylinder. The scale is that of the common barometer enlarged, as in the wheel barometer; when, therefore, the movements are said to amount to so many hundredths of an inch, it is to be understood as meaning that they are equal in value to that height of mercury. The scale can be enlarged so as to render movements of one four-hundredth of an inch visible to the unassisted eye. The only records of this instrument that I have seen state that the air contained in the water is given off when the pressure is removed, and so renders its indications incorrect; also that this imperfection is irremediable. This depression, amounting in one year, in my first experiment, to only .02 of an inch, has led me to suppose that the depression which caused the plan to be set aside was owing to the force of vapor, which was not so well understood at that time as at present; and as many variations of pressure are easily seen in this barometer, which would escape notice in the mercurial

one, and, if not attended to, give rise to error, I think it will prove a valuable addition to a standard barometer, though never a substitute for one. In hopes of getting rid of the air, and of lessening the correction required for the force of vapor, I tried several fluids in place of pure water. Among these was oil of turpentine ; this caused a rapid evolution of gas and blackening of the mercury, and depressing the column several inches in a few minutes. A saturated solution of muriate of soda seemed at first more successful ; but in a short time the column became depressed ; and this depression continuing to increase at a regular rate, the tube was emptied, when it was found that the salt, having crystallized between the mercury and the glass, had so allowed the air to enter. A solution of muriate of lime, not being crystallizable, was next tried ; and this seems to stand best, as yet having sunk in two and a half years only .03 of an inch, the greater part of this depression having occurred in the first few months, giving rise to the surmise that the air which has caused it was left in at the time of filling, and has not crept in since. The addition of the salt to the water, besides removing to a great extent the air, has the effect of diminishing the correction required for the force of vapor. The last-named solution has its boiling point at 234° F., and, as has been shown by experiments, the tension of vapor from water and watery solutions of salts is the same at an equal number of degrees below their boiling points. The correction to be applied is lessened to that of pure water 22° lower than the observed temperature. This correction, which is to be added, and that for the expansion of the fluids, which is to be subtracted, thus nearly neutralizing each other at low temperatures, I have applied, by means of a movable scale, in the same way as is used in the sympiesometer. Among the slighter variations shown by this barometer may be mentioned the oscillations during a gale of wind ; these are quite as conspicuous in this barometer as they were observed by Prof. Daniell in the water barometer, amounting frequently to 0.03, and once to 0.4 of an inch ; they vary in duration from five to seven seconds ; they begin with a short, quick rise, followed by a slower and a much greater descent, and then a return to the point of rest, which is much nearer the top than the bottom of the oscillation. Previously to a gale of wind, the column descends by jerks and with irregular rapidity ; but on one occasion, on which no wind followed for two days, the column fell without the slightest jerk more than half an inch ; there was, however, a heavy and long-continued fall of rain. During heavy and sudden showers the column rises, and falls again on the cessation of the shower ; on one occasion the rise was .02 of an inch. In a room with a fire, with a door and window shut, the column is lower than when the window is open ; the difference is usually .005, but with a good fire, .01 of an inch. The last two causes are very likely to give rise to error ; and the better the barometer, the greater will be the error.

STEREOSCOPIC COSMORAMIC LENS.

This is a modification of the beautiful instrument invented by Sir David Brewster. The improvement consists in employing, in place of the two small semi-lenses, one large one, which is rendered stereoscopic by cutting an ordinary plano-convex lens in half, removing more or less of the opposite outer diameters, and then transposing the pieces so that the original centre of the lens becomes the two sides, and the outer edges come together in the middle. The advantage obtained by this arrangement is an increased facility for viewing as one the double pictures. Only one adjustment is necessary for all sights; viz., increasing or diminishing the distance between the lens and the double picture.

SELF-REGULATING METEOROLOGICAL REGISTER.

At the last meeting of the American Association for the promotion of Science, Prof. Webster, of the Virginia Collegiate Institute, read a paper describing a most ingenious, yet marvellously simple, instrument for registering meteorological observations. It consisted of a common clock, the weight of which, instead of running down within the case, runs over two pulleys and down by the side of a cylinder, placed vertically on its end. In the side of the weight a pencil was placed. The cylinder is surrounded by a sheet of clean paper, on which are ruled thirty-two vertical lines, to represent the different points of the compass, and twenty-four horizontal lines, to indicate the hours of the day. Through the cylinder runs a rod, which connects above with a vane; and as the vane turns, the rod and the cylinder turn. Let the pencil in the weight be placed so near that the point presses upon the paper on the cylinder. Now, if it is calm, the weight running down makes a perpendicular line on the paper; but if the wind shifts, the mark on the paper veers to right or left. If suddenly, it leaves a horizontal mark; if by degrees, it goes down diagonally. You have to wind your clock when you go to bed, as usual — that is all the trouble — or, get an eight-day clock, and, by making eight times twenty-four horizontal lines on the paper for as many hours, you wind it but once a week.

CURIOUS OPTICAL PHENOMENA.

At the London Polytechnic Institution, a new experiment of a beautiful kind, the invention of a French philosopher, is now being exhibited. It consists in the illumination of the interior of a jet of water, emitted horizontally, and falling into a curve. The light, which is of great brilliancy, is applied at the back of the jet. It seems to be wholly absorbed, and bent out of its lateral rectilinear direction by the falling stream of water, every part of which is rendered perfectly luminous.

Even the glass vessel, into which the stream falls, is occasionally illuminated. By placing various colored glasses between the light and the water, the jet is made to assume the most beautiful hues.

BABINET'S NEW PHOTOMETER.

This photometer consists of a tube, at one end of which is a Nichol's prism, through which the light to be valued is admitted, the radiant or source of the light being placed at a measured distance. As it passes along the tube the light encounters a bundle of glass plates, through which, as it passes, it is polarized by refraction. It then passes on and is received at the eye pieces ; another tube, furnished also at its extremity with a Nichol's prism, also enters the side of this first tube at such a place and at such an angle as that light admitted from a standard source at a fixed distance is reflected to the eye piece by the same bundle of parallel glass plates through which the former light is refracted. By turning the Nichol's prisms, exact complementary colors can be had from each source ; and where the images of oblong slits, through which the light passes, are made to cross at the eye piece, the crossed part will be free from either color when the light to be tried is at exactly the distance which gives the same intensity to the light which enters the instrument as that which comes from the standard. A comparison of the squares of these distances gives the intensity of the light to be valued in the usual and well-known method.

ON SOME TRACES OF HARMONIOUS COLORS IN PLANTS AND THE PLUMAGE OF BIRDS.

The following is an abstract of a paper on the above subject, read to the British Association by Prof. M'Cosh, of Belfast, Ireland :—

In commencing he remarked, that for several years past he had been convinced, that the colors of plants would be found in beautiful accordance with the law of harmonious colors. Taking up the three secondary colors, green, purple and orange, he showed that when these colors are found in nature they have often the corresponding harmonious colors in juxtaposition : 1. *Green harmonizing with Red and Russet.*—This is the most common harmony in the vegetable kingdom. Harmonizing with the green leaves of plants, we have often red flowers and red fruit. The eye delights to see the red berries peeping forth from the green foliage of the mountain-ash or holly. Not unfrequently, also, the green leaves harmonize with the red or russet of the young stems and leaf-stalks. 2. *Purple harmonizing with Yellow or Citrine.*—This is the second most common harmony. So far as he had been able to observe, purple of various shades and hues—such as red-purple where there is a preponderance of red, and blue-purple where there is a preponderance of blue—is the most common color of the petals of plants. Contrasting with it, we have often a yellow

heart in the plant; very often the anthers and pollen are yellow. It is interesting to notice, that, according to the hue of the purple, so is the hue of the contrasted yellow. Thus, in the potato and bitter-sweet the flower is blue-purple and the stamens are red-yellow,—while in the garden polyanthus the outer rim of the corolla is red-purple and the heart is greenish-yellow. The harmony between purple and citrine may be seen in decaying vegetation. 3. *Orange harmonizing with Blue and Olive.*—This harmony is less frequent; still it is found in nature. Plants with a blue flower have often orange anthers, and some syngenesious plants have an orange flower and an olive involucre. He had found it extremely interesting to trace this harmony through the vegetable kingdom. Sometimes the harmonious colors are on the same organ. Thus blue and orange are found on the petals of the forget-me-not, yellow and purple on the pansy, calceolaria, mimulus, antirrhinum, &c. More frequently the harmonious colors are found on different organs. Thus, we have frequently purple petals with yellow anthers. Often the corolla is of one color, and the calyx the complementary color. He went on to say that the final cause of all this was very evident; the arrangements are in accordance with the structure and likings of the eye. But there must also be an efficient cause. Possibly this was to be found in the chemical changes of plants, and the relation of chemical agents to colors. But it is, surely, also possible that there may be a reality in color as there is in heat. This juxtaposition of contrasted colors in plants does look as if there were polar forces operating in the distribution of colors. On the supposition that color is in the object, we can account for color as seen by the eye by supposing that every color on the surface of an object repels the like color, and allows the others to be absorbed. This was, however, but a vague hypothesis, in the absence of a better, and was not to be confounded with the coördinated facts which he had presented in regard to harmonious colors in plants. Dr. M'Cosh went on to say that he had also noticed traces of harmonious colors in the plumage of birds. 1. Black and white found in birds of tamer and plainer plumage. 2. The second most common harmony is a red-yellow, associated with a dark-blue. This reddish-yellow takes various hues; sometimes it is a tawny color, at other times orange, and in some birds it is a bright scarlet. The blue is also of various shades and hues, sometimes being a kind of dark-gray, at other times a very blue-purple, and not unfrequently of a greenish tinge. 3. In the more ornamented birds, the harmonious colors are green and red. Sometimes we have a bluish-green with a scarlet, at other times a yellowish-green with a blue-purple.

ON ASSOCIATIONS OF COLOR AND RELATIONS OF COLOR AND FORM IN PLANTS.

In a communication presented to the British Association on the above subject by Dr. G. Dickie, he remarked that relations in the form, structure, number and position of organs are familiar to every botanist: *a priori* it

might have been inferred that order prevails also in the distribution of colors. This is not only the fact; there are, besides, obvious indications of a relation between the color and form of certain organs.

The presence of all the colors, red, yellow and blue, which form compound or white light, is a physical want of the organ of vision. Among the lower tribes of plants, the algæ may be mentioned as remarkable examples of constantly associated colors. Such in fact is Prof. Harvey's classification, who divides them into red, green and olive. Among the red there are many which have a red-purple hue; and among the olive, not a few are yellow-green. Red and green are complementary, and red-purple and yellow-green stand in the same relation. Among mosses, we find the red or red-purple peristome associated with the green or yellow-green capsule, and the same is true of their stems or leaves. In flowering plants, the associations of certain colors are so numerous that it is unnecessary in this summary to do more than mention a few examples. In the leaves of Caladiam pictum, Coleus Blumei, and Victoria Regia, we find red or red-purple associated with green or yellow-green. The same is true of the pitcher-like organs of Sarraceniæ, Nepenthes, and Dischidia. In the flower, similar associations of various kinds are common. We need not expect to find in a corolla or any other organ the primaries, red and yellow, or blue and red, associated and in contact. The red has green, the yellow has purple, and the blue has orange associated. Of the primaries, blue is rarest,—many cases so denominated being, in fact, red-purples. In the flower yellow predominates; hence the very general diffusion of purple of various degrees of intensity. Purple being of such general occurrence in the flower, we can now understand why yellow is the most common color of pollen: some exceptional cases seem to confirm this; in the turn-cap lilly, for example, the red pollen is associated with the green filaments. The color of the flower may have its complement in that of other parts, as the stem, leaf, &c. Sometimes the associated colors are not visible at the same time. The inside of a ripe fig is red-purple, the outside yellow-green. Sometimes a yellow corolla is succeeded by a purple fruit. Direct exposure to light, although usually and in general correctly admitted to have a direct relation to intensity of color in organisms, appears not to be necessary in every instance. The plant, however, must receive the light at some part or other, in order to produce that intensity of color observed in the coats of seeds, in the interior of fruits, and in the tissues of subterranean organs. In conclusion — 1. The primaries, red, yellow and blue, are generally to be seen in some part of the plant. 2. When a primary occurs in any part of the plant, its complement will usually be found in some other part, or at some period or other of the development of the plant. I have found in not a few instances, in the animal kingdom, similar associations of color; birds, mollusca and radiata present many obvious examples. We may next examine the relation between color and form; and the remarks are, for the present, confined to the flower. Law 1. In regular polypetalous and gamopetalous corollæ the color is uniformly

distributed. That is to say, the pieces of the corolla, being all uniform in size and shape, have each an equal proportion of color. Examples of this occur in Primulaceæ, Boragineæ, Ericaceæ, Gentianeæ, Papaveraceæ, Cruciferæ, Rosaceæ, Cactaceæ, &c. Law 2. Irregularity of corolla is associated with irregular distribution of color. The odd lobe of the corolla in such is most varied in form, size and color. When there is only color, it is usually more intense in the odd lobe. When there are two, one of them is very generally confined to the odd lobe. Sometimes, when only one color is present, and of uniform intensity in all the pieces, the odd lobe has spots, or streaks, of white. The odd lobe, therefore, in irregular flowers, is distinguished from the others not merely by size, form and position, but also by its color. Papilionaceæ, Labiatæ, Scrophularineæ, &c., are examples. In some cases, as Gloxinia, Achimenes, Rhododendron, &c., in which irregularity of flower is less marked, the two pieces on each side of the odd lobe frequently partake of its character as regards color. In some thalami-florous Exogens, (as Pelargonium, Tropæolum, Æsculus,) &c., with irregularity of flower, owing chiefly to difference in the size of the pieces, the largest are most highly colored. Law 3. Different forms of corolla in the same inflorescence often present differences of color, but all of the same form have the same color. The Compositæ are examples; when there are two colors, the flowers of the centre have one color, and uniform in its intensity; those of the circumference also agree in this respect, but have the other color. The first two laws prevail in monocotyledons as well as in dicotyledons. In the former the calyx and corolla generally resemble each other in structure, shape, and in color also. The law of contrasts is, therefore, simpler in monocotyledons than in dicotyledons. The former may be symbolized by the triangle, three and six being the typical numbers in the flower; the latter by the square or pentagon, four and eight, five or ten, being the prevalent numbers. Simplicity of figure corresponds with simple contrast of color in the one, while greater complexity of color and of structure are in direct relation in the other. According to the investigations of Brongniart, there has been progressive increase of angiospermous dicotyledons up to man's epoch. Among them we find the floral organs with greater prominence in size, form and color, and such prominence of the "nuptial dress" of the plant is peculiarly a feature of species belonging to natural families which have attained their maximum in man's epoch and are characteristic of it.

Mr. Warrington gave an account of some experiments he had made on the influence of colored glass on the growth of plants in sea-water. He found the red sea-plants grew best in glass cases colored green, and that green Confervæ were thus destroyed. Mr. Huxley made some remarks on the general theory of harmony and adaptation in nature. He thought naturalists were too much disposed to take it for granted that beauty was an end in creation. He believed, on the contrary, that grotesqueness was frequently an object, and that inharmonious and inapposite colors and forms were purposely brought together, and thus excited the feeling of

the ridiculous. Dr. Carpenter called attention to the fact, that different chemical conditions of the plant produced chemical colors; and the point to be ascertained was, whether these were subservient to the laws of harmony sought to be established.

ON THE PRINCIPLES OF HARMONY AND CONTRASTS OF COLORS.

A work with the above title has recently been published by M. Chevreul, superintendent of the dyeing department of the royal (Gobelins) manufactory of France, the object of which is to prove and explain the influence of simultaneous contrasts of colors. M. Chevreul starts with the following axiom, or rather dogma, viz: "That every color, when placed beside another color, is changed, appearing different from what it really is, and moreover equally modifies the color with which it is in proximity."

In accordance with the above proposition, M. Chevreul deduces the following rules for the arrangement of colors in dress, for the selection of flowers for bouquets and the decoration of furniture, all founded upon strict philosophical laws:—

"*Red Drapery.*—Rose-red cannot be put in contact with the rosiest complexions without causing them to lose some of their freshness, as a former experiment has demonstrated—viz.: we were speaking of the inconvenience resulting from the use of rose-colored linings in the boxes of a theatre. * * * Dark-red is less objectionable for certain complexions than rose-red, because, being higher than the latter, it tends to impart whiteness to them, in consequence of contrast of tone.

Green Drapery.—A delicate green is, on the contrary, favorable to all fair complexions which are deficient in rose, and which may have more imparted to them without inconvenience. But it is not as favorable to complexions that are more red than rosy, nor to those that have a tint of orange mixed with brown, because the red they add to this tint will be of a brick-red hue. In the latter case a dark green will be less objectionable than a delicate green.

Yellow Drapery.—Yellow imparts violet to a fair skin, and in this view it is less favorable than a delicate green. To those skins which are more yellow than orange, it imparts white; but this combination is very dull and heavy for a fair complexion. When the skin is tinted more with orange than yellow, we can make it roseate by neutralizing the yellow. It produces this effect upon the black-haired type, and it is thus *that it suits brunettes.*

Violet Draperies.—Violet, the complementary of yellow, produces contrary effects; thus, it imparts some greenish-yellow to fair complexions. It augments the yellow tint of yellow and orange skins. The little blue there may be in a complexion it makes green. Violet, then, is one of the least favorable colors to the skin, at least when it is not sufficiently deep to whiten it by contrast of tone.

Blue Drapery.—Blue imparts orange, which is susceptible of allying itself favorably to white and the light flesh tints of fair complexions, which have already a more or less determined tint of this color. Blue is, then, suitable to most blondes, and in this case justifies its reputation. It will not suit brunettes, since they have already too much of orange.

Orange Drapery.—Orange is too brilliant to be elegant; it makes fair complexions blue, whitens those which have an orange tint, and gives a green hue to those of a yellow tint.

White Drapery.—Drapery of a lustrous white, such as cambric muslin, assorts well with a fresh complexion, of which it relieves the rose color; but it is unsuitable to complexions which have a disagreeable tint, because white always exalts all colors by raising their tone; consequently it is unsuitable to those skins which, without having this disagreeable tint, very nearly approach it. Very light white draperies, such as muslin, plaited or point lace, have an entirely different aspect. * * *

Black Drapery.—Black draperies, lowering the tone of the colors with which they are in juxtaposition, whiten the skin; but if the vermilion or rosy parts are to a certain point distant from the drapery, it will follow that, although lowered in tone, they appear relatively to the white parts of the skin contiguous to the same drapery redder than if the contiguity to the black did not exist."

The delicate perception of beauty that the young may be trained to from the education of the sense of sight, may be gathered from the following laws of discord in the grouping of flowers :—

"We must separate pink flowers from those that are either scarlet or crimson, orange flowers from orange-yellow flowers, yellow flowers from greenish-yellow flowers, blue flowers from violet-blue flowers, red flowers from orange flowers, pink flowers from violet flowers, blue flowers from violet flowers."

The subjoined rules of taste in furniture show the pleasure that we lose from the possession of that bound genii, that unintelligible talisman, a dormant sense :—

"Nothing contributes so much to enhance the beauty of a stuff intended for chairs, sofas, &c., as the selection of the wood to which it is attached; and, reciprocally, nothing contributes so much to increase the beauty of the wood as the color of the stuff in juxtaposition with it. After what has been said, it is evident that we must assort violet or blue stuffs with yellow woods, such as citron, the roots of the ash, maple, satin-wood, &c.; green stuffs with rose or red-colored woods, as mahogany. Violet or blue-grays are equally good with yellow woods, as green-grays are with the red woods. But in all these assortments, to obtain the best possible effect it is necessary to take into consideration the contrast resulting from height of tone; for a dark-blue or violet stuff will not accord so well with a yellow wood as a light tone of the same colors; and it is for this reason that yellow does not assort so well with mahogany as with a wood of the same color, but not so deep. Among the harmonies of contrast of tone

that we can make with wood which we leave of the color which is peculiar to it, as ebony, its brown color permits its employment with light stuffs to produce contrasts of tone rather than contrasts of color. We can also employ it with very brilliant, intense colors ; such as poppy, scarlet, aurora, flame-color, &c."

The following subtleties may be useful to men in trade :—

"*First Fact.*—When a purchaser has for a considerable time looked at a yellow fabric, and he is then shown orange or scarlet stuffs, it is found that he takes them to be amaranth-red, or crimson, for there is a tendency in the retina, excited by yellow, to acquire an aptitude to see violet, whence all the yellow of the scarlet or orange stuff disappears, and the eye sees red, or a red tinged with violet.

Second Fact.—If there is presented to a buyer, one after another, fourteen pieces of red stuff, he will consider the last six or seven less beautiful than those first seen, although the pieces be identically the same. What is the cause of this error of judgment? It is, that the eyes, having seen seven or eight red pieces in succession, are in the same condition as if they had regarded fixedly during the same period of time a single piece of red stuff; they have then a tendency to see the complementary of red ; that is to say, green. This tendency goes of necessity to enfeeble the brilliancy of the red of the pieces seen later. In order that the merchant may not be the sufferer by this fatigue of the eyes of his customer, he must take care, after having shown the latter seven pieces of red, to present to him some pieces of green stuff, to restore the eyes to their normal state. If the sight of the green be sufficiently prolonged to exceed the normal state, the eyes will acquire a tendency to see red ; then the last seven red pieces will appear more beautiful than the others."

ON COLOR OF THE WATER OF THE MEDITERRANEAN SEA.

"The usual tint of the Mediterranean Sea, when undisturbed by accidental or local causes, is a bright and deep blue; but in the Adriatic a green tinge is prevalent ; in the Levant Basin, it borders on purple ; while the Euxine often has the dark aspect from which it derives its modern appellation. The clear ultramarine tint is the most general, and has been immemorially noticed, although the diaphanous translucence of the water almost justifies those who assert that it has no color at all. But notwithstanding the fluid, when undefiled by impurities, seems in small quantities to be perfectly colorless, yet in large masses it assuredly exhibits tints of different intensities. That the sea has actually a fine blue color at a distance from the land cannot well be contradicted ; nor can such color—however influential the sky is known to be in shifting tints—be considered as wholly due to reflection from the heavens, since it is often of a deeper hue than that of the sky, both from the interception of solar light by the clouds, and the hues which they themselves take. This is difficult to account for satisfactorily, as no analysis has yet detected a sufficient quan-

tity of coloring matter to tinge so immense a body of water: wherefore Sir Humphrey Davy's supposition of an admixture of iodine cannot be admitted, for its presence is barely traceable under the most careful analysis. Those who contend for there being no color at all, may remind us that the blue rays are the most refrangible, and that, being reflected in greatest quantity by the fluid, (which, because of its density and depth, causes them to undergo a strong refraction,) they cause a tint which is only apparent. Be that as it may, seamen admit of one conclusion—namely, that a green hue is a general indication of soundings, and indigo-blue of profound depth."—*Admiral Smyth on the Mediterranean.*

ON TRANSPARENCY OF THE OCEAN.

A communication on the above subject was made to the American Scientific Convention, at the Washington meeting, by Captain Glynn, U. S. N.:—

Philosophers ashore and philosophers of the forecastle, said Capt. Glynn, have wondered in all times as to the causes and extent of the color of the sea, and queried how far into it our vision could penetrate. Capt. Wilkes advanced the opinion that the transparency of the sea varied quite directly with its temperature. To this his observations did not allow him to assent. In order to obtain correct observations, the surface of the sea must be perfectly tranquil and smooth. There must not be a ripple on it. So essential is this point, that, during a cruise of four years, he only succeeded in making sixteen observations that proved worth saving. Of these sixteen, in only one the water was ruffled by a slight breeze. The next trouble was to discover what object would be most likely to reflect all the rays of light—what would be longest visible. First we tried an iron pot, painted white. When we looked for it for the second experiment, the white pot was a black one again. Next we tried a sphere of hoops, covered with white cotton cloth. Before it was called for the second time, it was smashed into a cocked hat. Next we tried a mere hoop, covered with a canvas. It was laid away on some old spikes; and when needed next, it came up sound enough, but of a bright yellow. At last we took a common white dinner-plate. It was good enough. It was the brightest object we could find, was always handy, and was always clean. It was slung so as to lie in the water horizontally, and sunk by an iron pot, with a line. The observations were taken wherever we could get them—ranging over 200° of latitude, in different oceans, in very high latitudes, and near the Equator. I have to assume, what doubtless I may, that they do not differ from what they would if taken all in the same place. At every station we noted in the connection, the sun's latitude, the velocity of the current, the temperature of both the air and the water, and the number of fathoms at which the plate was visible below the surface. We took these observations from a boat, bringing the line on to its shady side—then leaning over, with faces almost touching the water, and eyes shaded from the

reflected rays from the surface by the brims of our tarpaulings, we watched for the disappearance of the plate as it was slowly let down. The varying points between which it disappeared from the vision of all, and where all could see it, never were farther separated than the length that the line could be lifted or let down by a reach of the arm—not over four feet. The water varied thermometrically from 40 to 85°

The results proved, that the lowest degree of temperature gave the shortest line of visibility ; and at the point where the water was the warmest, there we saw the plate at the greatest depth. On two occasions we saw the plate when it was 25 fathoms below the water's surface, and on one of these the water was at 85°. On these occasions, all noticed the extraordinary clearness of the water. To lie in the boat and look down, was like looking down from the mast-head. Objects were as clearly defined to a great depth. On this occasion I tried if a contrast of colors would increase the visibility. I so placed the plate upon the pot that a periphery of the black surface surrounded the white plate, but it made no difference at all.

Capt. Glynn thought that *the maximum of visibility* under water, under the most favorable circumstances, *is twenty-five fathoms*. But between the highest and lowest points of visibility, which corresponded with the highest and lowest points of the water's temperature, there were great variations, which showed no direct correspondence between the temperature and the line of visibility.

At the mouth of the Mississippi we find the water no more transparent than so much muddy water. The farther we get from the points where earthy matters in large quantities are washed in, the clearer the water is. Now the Pacific, like the Atlantic, is a great whirlpool—a tide flowing entirely around its circumference. In latitude 20° on the west side of the Pacific, farthest removed from all stormy quarters, and where the ocean is stillest, we found the greatest transparency of water. Off Cape Horn, where eternal storms drive up the dirt torn by glaciers and icebergs from the regions around the Pole, the water was exceeding turbid. With the thermometer at 68°, we got only ten fathoms of visibility.

IMPROVEMENTS IN PHOTOGRAPHY.

The interesting and beautiful science of sun-painting is making rapid and curious advances. A large bridge is being built over the River Volga by command of the Czar, who was so impatient to have it completed that he made frequent long expeditions to the works, that he might use Nature's own stereoscoptics with the enkephalic images implanted in his own imperial "camera obscura." The architect, however, has now made matters more pleasant probably to all parties, by preparing, twice a month, a pair of stereoscopic images of the works as they progress, which he forwards to the Emperor, who sits in his own study, and sees through this new and curious sort of spyglass how they are getting on at the Volga. Another new

mode of making use of the phototype consists in casting a magnified copy of a sun portrait on canvas for the aid of portrait-painters, who thus sketch from Nature's sketches. In a recent sitting of the *Société d'Encouragement pour l'Industrie Nationale*, at Paris, according to *Galignani*, it was stated that a photolithographic process, which has so long been desired, has at length been discovered. It was thus described: An ordinary lithographic stone is taken, and a solution of *bitume de Judée* (Jew's pitch) is placed on it. A negative photographic proof is then put on it, and is pressed on the stone for a period which may vary from ten minutes to four or five hours. The page is then washed in pure ether, which soon evaporates. The figure is then found properly marked with its lights and shades, and it may be inked and drawn off as in ordinary lithographs.

During the past summer in the Baltic, the British steamers employed in examining the enemy's coasts and fortifications took photographic views for reference and minute examination. With the steamer moving at the rate of fifteen knots an hour, the most perfect definitions of coasts and batteries were obtained. Outlines of the coasts, correct in height and in distance, have been faithfully transcribed; and all details of the fortresses passed under review of the photograph are accurately recorded.

At the Royal Greenwich Observatory, the beautiful system of registering magnetical and meterological changes, by means of photography, continues to be employed, and efforts have been made to multiply copies of the Photographic Registers. After many experiments, it was found that, by the agency of sunlight upon the back of an original photograph, whose face was pressed closely, by means of a glass plate, upon proper photographic paper below, there would be no difficulty in preparing negative and inverted secondaries, and, from them, positive tertiaries. Thus, beyond the trouble which the process involves, Mr. Airy anticipates that it will be easy to multiply copies to any extent which may be desired.

The photographic apparatus in use at the Royal Observatory, for taking magnetic observations, is constructed as follows: Each magnetic bar is made to carry a little mirror, which reflects the light of a lamp upon a piece of photographic paper, kept constantly moving behind an opaque plate, having but one small vertical opening. On this, for every minute of the twenty-four hours, each vibration of the needle is faithfully recorded. The chemical radiations of an Argand lamp supply the observer's place; and at the same time that it records every change in the phenomenon of terrestrial magnetism, it is made to mark the most delicate alterations in atmospheric pressure, and to note every increase or diminution of temperature. At Greenwich, the magnets, the barometers, and the thermometers are all registered by the chemical power of light; and MM. Faye and Gonjon, at Paris, knowing the error of the human eye in observations on a bright object, have substituted the daguerreotype plate for the purpose of ascertaining the actual diameter of the sun, and they propose to the principal observatories of Europe to determine, by a similar method, the absolute time.

The Committee of the British Association, having the Kew Observatory in charge, have undertaken, at the suggestion of Sir John Herschel, to secure by means of photography a daily record of the appearance of the sun's disk, with a view of ascertaining, by a comparison of the spots upon its surface, their places, sizes and forms, whether any relation can be established between their variations and other phenomena. The method proposed by Sir John Herschel for accomplishing this object is as follows :—

"The image to be impressed on the paper (or collodionized glass) should be formed, not in the focus of the object-lens, but in that of the eye-lens, drawn out somewhat beyond the proper situation for distinct vision, (and always to the same invariable distance, to insure an equally magnified image on each day.) By this arrangement a considerably magnified image of the sun, *and also of any system of wires in the* focus of the object-glass, may be thrown upon the 'focusing-glass' of a camera box adjusted to the eye-end of the telescope. By employing a system of spider lines parallel and perpendicular to the diurnal motion, and so disposed as to divide the field of view into squares, say of five minutes in the side, the central one crossing the sun's centre, (or rather, as liable to no uncertainty, one of them being a tangent to its lower or upper limb,) the place of each spot on the surface is, *ipso facto*, mapped down in reference to the parallel and declination circle, and its distance from the border, and its size, measurable on a fixed scale. If large spots are to be photographed specially with a view to the delineation of their forms and changes, a pretty large object-glass will be required, and the whole affair will become a matter of much greater nicety; but for reading the daily history of the sun, I should imagine a three-inch object-glass would be ample. The representations should, if possible, be taken daily, and the time carefully noted."

Sir John does not think that a very powerful telescope would be requisite, but that it should be equatorially mounted, and with a clock-motion in parallel.

VITRIFICATION OF PHOTOGRAPHIC PICTURES.

The author of this process, M. Plaut, first procured a photograph on glass covered with albumen, and subjected it gradually to a strong heat, so as to redden the glass. The albumen was destroyed, and the photograph, if negative, became positive by reflection. The picture was made of pure silver, which adheres quite strongly to the glass, so that it may be polished without alteration.

On exposing this glass to the action of hydrofluoric acid in vapor, an engraving of the design is obtained over parts not covered by the image formed of the silver. It may also be possible to strengthen the image by a galvanic deposit, and make a kind of plate from which engravings could be taken.

If, in place of arresting the process at a red heat, it is continued until

the glass enters into fusion, the image sinks into the interior of the glass without being altered, and covers itself with a vitreous varnish. It appears like a design of great delicacy, enclosed between two plates of glass ; and, if positive proofs are employed, the method may be used for making pictured glass which may, without doubt, be colored by the ordinary processes.— *Silliman's Journal.*

HELIOGRAPHIC ENGRAVING.

The following process, invented by M. Baldees, appears to bring to perfection the mode of engraving by the sun. The results obtained are very beautiful ; and although the author has not described to us fully all the details, we know enough to give a general idea of his method.

On a plate of copper covered with petroleum, a photographic proof on paper of the object to be engraved is placed. This proof is a positive, and will necessarily make a negative on the metal by the action of the light. After an exposure of a quarter of an hour to the sun, the image is reproduced on the resinous coating, but it is not yet visible. It is made to appear by washing the plate with a solvent, which removes the parts not impressed by the light, and brings out a negative picture made by the resinous tracings of the bitumen. The designs are very delicate. The tracings receive solidity by an exposure during ten days to the action of a diffused light. When thus hardened, the plate of metal is plunged into a bath of sulphate of copper, and is then connected with the pole of the battery. If with the negative pole, a layer of copper in relief is deposited on the parts of the metal not protected by the resinous coating. If with the positive pole, the metal is graved out in the same parts, and thus an etched engraving is obtained.—*Paris Correspondence Silliman's Journal.*

NATURE DOING HER OWN ENGRAVING.

In the fifth volume of the Denkshriften of the Royal Academy of Sciences, at Vienna, there is a paper by M. Ayer, and numerous plates illustrating a new style of engraving. The plates represent leaves, plants from an herbarium, lace and other objects, and in each case the object appears to be *on the paper*, the surface being raised and the coloring perfect. The deception is so complete that without a magnifying glass it is almost impossible, in one or two instances, to be sure that the object itself is not there. The process employed is the following : The pressed plant, or other object, is placed between a plate of copper and one of lead, and subjected to pressure. The original thus produces a strong impression on the lead plate. By inserting the requisite colors with a point in the depressions, a figure colored to nature, with different colors in its different parts, may be obtained at a single printing. From the lead plates copies may be taken by stereotype or galvanism, and copper plates are thus obtained more durable than those of lead. Gutta-percha may be used in

place of lead; and by covering it with a deposit from a silver solution, the impression may be used for stereotyping or electrotyping.

ON THE COLORED IMPRESSIONS PRODUCED BY THE CHEMICAL ACTION OF LIGHT.

The following communication, by M. Becqueral, is taken from the Comptes Rendus, July, 1854.

The chemical action of light has enabled me, as is well known, to render perceptible the electrical effects produced by reactions operating under the influence of luminous rays. On the other hand, it is more than six years since I was led to the observation of this fact, that it was possible to prepare a surface which should be chemically capable of taking impressions from light, so that it should become of precisely the same color as the luminous ray which strikes it. The sensitive matter possessing this remarkable property is a chloride of silver, which may be called the violet chloride, containing less chlorine than the white chloride, and, in general, mixed with the latter. The chloride of silver of which I speak being able to be placed in such conditions that it will only be affected between the limits of refrangibility of the rays which are perceptible to the organ of vision, it was important to study attentively in what manner it would behave in the apparatus which I have named the *electro-chemical-actinometer*; what would be the effects resulting from the action of the different luminous rays whose intensity would be caused to vary within the determined limits; and, finally, whether it would be possible to establish a photometrical method based on different principles from those generally in use. This study I commenced some time since; but I have found it necessary to reëxamine the different circumstances which accompany the preparation of the sensitive matter, and the modifications which heat and light produce, before the luminous rays have given color to it. Such is the aim of the work I have now the honor of presenting.

In former publications I have described various means by which we can obtain colored impressions on surfaces covered with violet chloride of silver; but that which gives the best effects consists in decomposing rapidly, by an electric current, a solution of hydrochloric acid in water, and causing the chlorine to pass to a plate of silver placed at the positive pole of the battery. This process is rendered of easy and certain application, by determining, in each circumstance, and at every minute, the quantity of chlorine which passes over the silver plate. For this purpose we interpose, in the voltaic circuit, a voltameter of water, so that the current which decomposes the hydrochloric acid, and carries the chlorine over the silver, likewise decomposes the acidulated water; the electro-chemical decompositions taking place in definite proportions, the same volume of chlorine is carried over the silver as there is disengaged of hydrogen gas in the eprouvette, placed above the negative electrode of the voltameter. The other side of the plate is protected by a varnish, so that the chlorine passes

only over one side. The proportion of chlorine necessary for the experiment varies in the following proportions :—

Vol. of chlorine at the pressure, per square decimeter of surface.	Thickness of the Sensitive Layer.	
	According to the order of tints of the thin layers.	Supposing the specific gravity of the chloride of silver equal to 5.27.
CUB. CENT.		MM.
2.80	Commencement of the layer of the second order.	0.00068
From....3.80 to 3 90	Layer of the third order	From 0,00092 to 0.00095
From....6.50 to 6.90	Layer of the fourth order giving beautiful colored reproductions of the luminous spectrum.	From 0.00158 to 0 00163

In the Memoir will be found all the indications relating to the different circumstances of the preparation of the sensitive layers, circumstances which should not be neglected.

By employing a thicker layer than those above mentioned, the results obtained will not be so satisfactory. We should therefore operate between the limits of from 4 to 7 cubic centimeters of chlorine at the ordinary pressure per square decimeter of the surface of the silver; but in these conditions, the thinner the layer, the more sensitive will the surface be, but the less beautiful will be the tints obtained.

If we project a luminous spectrum on to a sensitive surface thus prepared, we very soon gain an impression beginning with yellow and orange,—that is to say, with the most luminous portions of the prismatic image,—and extending to the red and violet texremities. This impression, as I have shown in a previous Memoir, reproduces the different shades of color of the spectrum. But the shades, although very bright, are very dark; and on the red side, between the lines *B* and *A*, and beyond *A*, the impression becomes violet, and darkens rapidly. When the preparation has been made according to the directions in this Memoir, no impression is reproduced beyond the violet; and except the black color on the red side, the image does not extend much beyond the limits *A* and *H*, and occupies the same extent as the visible spectrum.

If mixed luminous rays strike upon the sensitive surface, they leave, like the rays of the spectrum, a picture colored of the same shades as they themselves possess.

But this same substance, when subjected to the influence of heat or light before the action of the luminous rays, leads to remarkable results, of which I am now about to speak.

The action of heat modifies violet chloride of silver very much. An elevation of temperature of from 212° F. to 302° F. causes a change in

the color of the prepared plate, without causing it to lose all trace of chlorine, but at the same time it changes the mode of action of the various luminous rays. The diffused or direct solar light acts as white, instead of giving an impression of a gray color; and besides, the colored tints are light instead of dark, as before the operation. But the most remarkable part is, that, by keeping the temperature up to 86° F. or 97° F. for several days, the same end is attained, and with even better results. The yellow and green colors, which, except the action of the luminous spectrum at a high temperature on a plate which has been operated on, are not produced with clearness, appear in these conditions; moreover, the sensitive matter is more rapidly sensitive. The plates thus prepared may likewise be rendered useful for the reproduction of colored images in the camera-obscura.

We cannot attribute to a chemical action the effect produced on chloride of silver by a difference of temperature which is so slight, but maintained for several days. It is probable that in these circumstances a modification of the physical state of the sensitive substance takes place. This would then be an effect of the same kind as that which takes place in the formation of red phosphorus.

The action of the least refrangible rays of light is likewise very curious, for it leads to a result analogous to that obtained by prolonging the elevation of temperature on the plates. It appears, then, that in both cases molecular effects of the same order are produced. The luminous spectrum acts in the following manner on the chloride of silver, modified by the extreme red rays. The action begins as before with the orange, yellow, and green, then extends gradually towards the violet and red. All the tints corresponding to the colors of the spectrum are as bright as if the plates were annealed, but the prismatic impression is far more beautiful; and even the green, the yellow, and the orange have more brilliant tints than before the action of the extreme red rays. Therefore, to the advantage which is possessed by the chloride modified by the least refrangible rays over that which has been annealed, of giving the black ground upon which the different prismatic tints are depicted, is added that of preserving perfectly the yellow and green tints. On the red side, the image of the spectrum is brilliant only as far as *B*; beyond that limit, the black tint which is produced being the dominant one, no effect takes place during the first few moments. However, if in the first place the chloride has remained an insufficient time under the action of the extreme red rays, the solar spectrum still gives a dark impression beyond *B*, and even *A*.

We obtain with the matter thus modified by heat or by light very beautiful colored reproductions of the luminous spectrum. The figures of colored rings, and those given by crystallized plates traversed by polarized light, are likewise well represented in their various tints. We can likewise reproduce the images of the camera-obscura, which are, so to speak, painted by the light; but these reproductions, although brighter in color than any I have obtained before, have as yet only a scientific interest, and I cannot, as yet, hope for any application of them, as the impressions are

only retained in darkness. I have hitherto been unable to prevent the action of diffused light, which by degrees destroys these images ; it is only, so to speak, in a state of passage that the sensitive matter has the power of reproducing colors.

It will be seen, therefore, that the sensitive substance, whose method of preparation is described in this work, enables us to obtain, not only very remarkable effects of color, but likewise results which are susceptible of comparison, so as to observe the electrical effects due to the chemical action of light.

ON THE CONSTRUCTION OF LECTURE-ROOMS.

Prof. Henry of the Smithsonian Institution, at the Washington meeting of the American Association for the Promotion of Science, communicated some views respecting the construction of lecture-rooms, and upon architecture, of which the following is an abstract :—

A lecture-room should be so built as to exclude the external light, for it is not needed within, and prevent the waste of lights from our lamps. There should be no unnecessary void space to waste the heat, and light, and voice. Ventilation being properly cared for, the ceiling may be made quite low. The audience should be as near as possible to the speaker, and be as high as possible, consistent with good seeing on the part of the audience. The catoptric curve, if observed, gives every auditor a chance to see as well as to hear. It requires that the seats should so rise as to allow a direct line from the eye of each one to pass to the speaker, unobstructed by the heads in the seat before. The resonance of the room must be heeded. The room, large or small, will echo if naked and empty and the walls are hard ; and the larger it is, the greater the danger of echoes. Drape one or two sides of a room, and by absorbing the sound you prevent the resonance or echo, but do not drape the wall behind the speaker. He wants that to assist his voice in reflecting the sound to the hearers ; for, until you pass without "the limit of perceptibility," the reflection of the sound helps the hearer in gathering in the words spoken. A damp wall is not so likely to give an echo as a dry one, nor a thin as a thick one. An open door at the head of the speaker wastes his voice. The room should be so arranged that the audience may be as nearly as possible before the speaker. Wing walls behind him, cutting off the corners, are of service, both for reflecting the sound and for the hanging of pictures, drawings, maps, &c., so that they may be seen by all present. But this is the easiest part of the subject ; how to arrange a room where the speakers are to occupy different parts of a room, is far more difficult.

Architecture should be looked upon more as a *useful* than a *fine* art. It is degrading the Fine Arts to make them entirely subservient to utility. It is out of taste to make a statue of Apollo hold a candle, or a fine painting stand as a fire-board. But our houses are for *use*, and Architecture is substantially one of the useful arts. In building, we should plan the

inside first, and then plan the outside to cover it. Buildings should have an ethnological character. They should express to other ages the wants, customs, and habits of the age of their construction. A Grecian temple was intended for external worship. An old Greek would laugh to see us construct a Grecian temple for a treasury building or a meeting house. It should have no windows in it, and should be entirely too dark for such uses. But it is easier to copy than to originate; and hence our servility. The *material* should alter the character of the structure. The Crystal Palace was, *par excellence, the* building of the nineteenth century. Its material, its history, its purposes, were unprecedented. It is a want of the times to build so that our houses can be taken down and transported.

The most flourishing time for Architecture is while a people are in a semi-barbarous state. The Press supplants it in importance when it comes into use. A Gothic cathedral is good to worship in, but not at all fitted to preach in. A building admirably adapted to the wants of the twelfth century would be strangely out of place in the nineteenth.

The mind has no *innate* cognitions of beauty in architectural details. The stout marble pillar we recognize as essential to the support of a heavy weight only until we find a stouter pillar of greater ability to support weight, which yet may be of smaller dimensions. A bronzed iron pillar of a few inches diameter satisfies the mind; but if we paint it to look like stone, it seems insufficient, and our taste is shocked.

NOTES ON ACOUSTICS AND VENTILATION.

The prosecution of the works at the Washington Capitol having been transferred to the War Department, the Secretary at War deputed Captain Meigs to the special charge and direction of the works, which, under his supervision, have progressed in a manner highly creditable alike to the liberality of the American Legislature and the reputation of those to whom they have been intrusted. On examination of the reports from various officials employed in the erection of this structure, it is particularly observable that proper provisions for the effectual warming and ventilation, as well as the best means for insuring an equal dissemination of the voice of speakers, have been made during the progress of the works; and not, as is too often the case in our own country, left until after the completion of the building, when alterations are objectionable, not only from their inconvenience and expense, but from the apparatus, &c., involved in these matters being so frequently unsightly and out of all character with the architectural design of the structure wherein they are placed.

The results of the experiments and observations of Captain Meigs, in connection with the interior arrangements of the Washington Capitol, will be found to contain much that is exceedingly valuable and universally applicable. We give, therefore, his "Notes on Acoustics and Ventilation, with reference to the new Halls of Congress."

These notes were submitted to the consideration of Messrs. Bache and

Henry, who fully corroborated the principles laid down by Captain Meigs, and approved of their judicious application. The above gentlemen visited many of the most important buildings in Philadelphia, New York, and Boston, for the purpose of examining them in reference to their acoustic qualities, which examination completely established the accuracy of the observations of Captain Meigs.

Experience shows that the human voice, under favorable circumstances, is capable of filling a larger space than was ever, probably, enclosed within the walls of a single room. Herschel, in his admirable treatise on sound, gives a few instances which are instructive. Lieutenant Foster, on Parry's third Arctic expedition, found that he could converse with a man across the harbor of Port Bowen, a distance of 6,696 feet, or about one and a quarter miles. Dr. Young records that, at Gibraltar, the human voice has been heard at a distance of ten miles. If sound be prevented from spreading and losing itself in the air, either by a pipe or an extensive flat surface, as a wall or still water, it may be conveyed to a great distance. Biot heard a flute clearly through a tube of cast iron (the water pipes of Paris) 3,120 feet long. The lowest whisper was distinctly heard. In fact, the only way not to be heard was, not to speak at all.

The favorable circumstances seem to be a perfectly tranquil and uniformly dense atmosphere, absence of all extraneous sounds, absence of echoes and reverberation, vicinity of reflecting surfaces, and perhaps, in some measure, the presence of substances which conduct sound well. A pure atmosphere, being favorable to the speaker's health and strength, will give him greater power of voice and more endurance; thus indirectly improving the hearing by strengthening the source of sound, and also by enabling the hearer to give his attention for a longer period unfatigued.

The effect of echoes in a small room is generally unnoticed; the echo returns so quickly that the ear receives it as coincident with the original sound, to which it in that case merely adds strength, perhaps prolonging it very slightly. If the room be larger, and the echoing wall so distant that the interval is sensible, the echo makes confusion. If, on a calm day, we advance towards a wall, producing, at each step, some sound, we will find a point at which the echo ceases to be distinguishable from the original sound. The distance from the wall, or the corresponding interval of time, has been called by Professor Henry the limit of perceptibility. This limit will vary with the nature of the sound; if the sound be sharp and distinct, as that produced by striking some hard substance, we shall find the limit of perceptibility less than for the more prolonged sound produced by the voice. The limit will probably vary also with the acuteness of the ear, some persons being probably able to separate sounds undistinguishable to others. The general limit is probably about thirty or thirty-five feet. It should be ascertained exactly; and in constructing a room for public speaking, the height of the ceiling should not exceed this limit. The sound will then be strengthened to the speaker himself by the echo. The interval between the original and reflected sounds will be shorter for

all his hearers than for himself, as twice the path of the voice and echo for the speaker is considerably longer than the difference between the paths of the direct and reflected sounds of one of the auditors. The direct echo from the ceiling then becomes an advantage, by strengthening, without confusing, the sound. But echo acts in still another way—by being repeated between opposite surfaces. The effect is like the multiplication of the image of a candle between two opposite and parallel mirrors. I have noticed it in the long, unfinished room of the Smithsonian, where the sound produced by clapping the hands is repeated so as to resemble a laugh—ha! ha! ha! In this case, the distance between the end walls is such as to separate the successive echoes; but when the walls are nearer the sound becomes contiguous, and is the ringing sound often produced in speaking in empty rooms, and called reverberation. This might trouble us between the ceiling and floor of our room; but a thick carpet, absorbing sound, and not reflecting it, will remove this difficulty. The great size of the room needed for the meeting of the House of Representatives makes it impossible to bring the walls within the limit of perceptibility. Professor Reid proposed, in the House of Parliament, to make the ceiling high in the centre, declining towards the sides, with floors and galleries rising from the centre towards the walls—thus reducing the height and surface of the walls so as to diminish the quantity of sound reflected from them as much as possible. All regard for architectural beauty forbids the adoption of this construction, which seems to have been modelled upon an empty tortoise-shell. Breaking the walls into deep panels has also been proposed. But when we recur to the limit of perceptibility, we shall perceive that a panel or recess must be over thirty feet deep to separate the echoes from the bottom of the recess and from the face of the wall. The surfaces of mountains covered with trees and rocks return echoes. No wall of an inhabited apartment can be made rougher than these natural reflectors. A simpler and more effectual method of controlling the echoes from the walls will be, to cover them with drapery absorbent of sound. The echoes from the ceiling are thus turned to account, and those from the floor and walls guarded against; but the echoes from small objects and surfaces may still be troublesome unless provided for. The trunks of trees in the edge of a forest return together a distinct echo. The beams under the flooring of the Menai Suspension Bridge are instanced by Herschel as giving a curious echo; and even such small objects as the vertical iron rods composing the fence in front of the President's House will be found to return a singular whistling echo to the sound made by striking a smart blow upon the pavement on a still night. To guard against this, it will be sufficient to cushion the chairs and cover the desks with some material which will not reflect sound. This may seem, and may possibly be, an unnecessary precaution; but I wish to leave no possible cause of confusion unnoticed, and to point out what I consider the means to obtain, for the first time, a room perfect in its acoustic arrangements.

Having thus disposed of the question of echoes and reverberations, the

next essentials to perfect and distinct hearing are a tranquil atmosphere and the absence of extraneous sounds. I consider them together, as we shall find that the precautions essential to obtain the one will also secure the other. Windows, in cold weather, separating the warm air within from the cold air without, serve as refrigerators, cooling the air in contact with the glass. The air, thus rendered heavier, immediately falls, and a descending sheet of cold air is produced, which, on reaching the floor, spreads over it in a cold stratum, and, to persons of sensitive nerves or feeble health, causes great inconvenience, being felt as a draught upon the feet and legs. And many an unfortunate page has been blamed for leaving open a door, when the draught really has been caused by this air cooled by the closed glass of an adjacent window. The circulation thus produced of air of different densities is unfavorable to distinctness of hearing. As the ascending hot air along a stove-pipe, or heated wall, causes irregular refraction of light, and produces a tremulous appearance in all objects viewed through it, so sound, irregularly refracted, becomes less clear and distinct. If we exclude external windows, and light the room only from the roof, we get rid of this fruitful source of discomfort and indistinctness; at the same time we obtain a pleasanter light, ample for all useful purposes, as is proved by its adoption in all the best constructed picture galleries. We also exclude the sounds of the exterior, which, saturating the air, as it were, distract the attention, and even overpower the voice we wish to hear, as the diffused light of day causes the stars to disappear. Open windows for hearing will be worse than closed ones; they not only let irregular, disturbing currents of air in, but they let the voice out—acting like black spaces in the wall of a room, which do not return the light which falls upon them. The common mode of warming and ventilating public rooms is fatal to perfection of hearing. One or several columns of intensely heated air are introduced through holes in the floor. Being much warmer than the air of the apartment, they immediately rise to the ceiling. If the exit-apertures for foul air are above, this fresh and heated air alone escapes, having done nothing for the apartment except to cause whirls and currents, such as we see in a column of smoke passing from a chimney on a calm day. The irregular refraction of sound through these currents of unequal density tends greatly to produce confusion. If the exits for foul air are below, the hot air accumulates at the top of the room, and gradually displacing the cooler air, forces it out through these passages. Professor Reid relates that he has found the air near the ceiling of a room at the boiling temperature, while those on the floor were complaining of cold. Here we have strata of different densities and unequal refractive power, and hence confusion of sound. As the warm air must ascend to the top of the room, I propose to let it do so in a large trunk outside of the apartment, pass into a space above the ceiling, and thence, by numerous holes, find its way, as through a sieve, into the room. By a steam-driven fan, or other mechanical means, we can pump air, in any desired quantity, into any spot to which we choose to direct it. I would drive all the air

required for the supply of the room through a maze of hot-water pipes, raising the whole of it to the temperature desired — sixty or eighty degrees, as the case may be. If the room be thirty feet in height, and it be desired to change all the air in it every fifteen minutes, enough air should be pumped in above to cause a general descent of the whole body of air in the room at the rate of two feet a minute. This would be an imperceptible current. The exit should be made by numerous holes in the floor, perhaps through the carpet, or the risers of the platform on which are the members' chairs. Three important advantages would thus be gained: the avoidance of all eddies, a nearly homogeneous and tranquil atmosphere, and the immediate removal downwards of any dust from the carpet, which would thus be prevented from rising, to be inhaled into the lungs. To prevent the disturbance and contamination of the atmosphere by the gas-lights, I would place them above the glass of the sky-lights — the space between those in the ceiling and those in the roof being separated from the chamber into which the fresh air should be admitted. In summer, the same apparatus which sends in warm air in winter would supply a constant breeze; and if the temperature of the external air was too high, it might be cooled by jets of water from pipes in the air passages, or even by melting ice.

To recapitulate, then, I propose to place the ceiling at such a height as to be within the limit of perceptibility, and thus strengthen the voice; to destroy reverberation between the ceiling and the floor by a thick carpet on the latter; to prevent echoes from the walls, by drapery; from the chairs and desks, by cushioning or covering them; to keep out extraneous sounds, by making the room an interior apartment, lighted only from above; to secure a tranquil atmosphere, uniform in its density and refraction of sound, by excluding all currents of hot or cold air; to secure a constant supply of pure air at the temperature desired for the room by mechanical means, introducing the air through all parts of the ceiling, and taking it out through all parts of the floor—thus also to remove dust; to prevent all interference with ventilation by the lights at night, by placing them outside the room, above the sky-lights.

ON THE PRESENT STATE OF OUR KNOWLEDGE OF RADIANT HEAT.

At the British Association, 1854, Professor Powell presented a report of the above subject, supplementary to his former, read in 1832 and 1840. It consisted, in the first instance, of some preliminary remarks on the confusion introduced into the subject from the neglect of those well-marked distinctions which the author had long ago dwelt upon between the different *species* of rays, all included under the common name of radiant heat, but which had been shown to be materially different in their nature and properties. He then adverted to the theory by which all those different kinds of effects are ascribed to the absorption of rays emanating from hot

and luminous bodies, and which are all produced in the same manner, viz., by *undulations*, but of different *lengths*,—those of the greatest lengths having a heating, but not an illuminating, power;—those of less lengths a luminiferous property also;—those of still less lengths, little heating, but higher chemical power. The arguments of M. Melloni were specially dwelt upon; as also the striking confirmation derived from certain calculations founded on the wave theory, which assigned a limit to all refraction, according closely with that found experimentally for heat in rock salt.

In the discussion which followed, Prof. Stevelly begged to ask Prof. Powell and Prof. Thompson how, in their opinion, the expansion of bodies by increased extent of the vibrations or on the Dynamical theory increased heat was to be reconciled with the well-known fact, that four substances—water, antimony, cast-iron and bismuth—were known to expand in the process of cooling. Prof. Powell replied, that these cases alluded to by Prof. Stevelly constituted a difficulty in any known theory of heat, and were therefore not more adverse to the Dynamical theory than to any other. Prof. Thomson said, that besides those cases stated by Prof. Stevelly being no greater difficulty in the Dynamic theory than in any other, that theory seemed to hold out a hope of explaining these anomalies. In his opinion, water while cooling, for instance, began at its maximum density to approach that molecular arrangement which it fully and fixedly attained in the act of solidifying. Prof. Stevelly said he was not satisfied with the answer, that this was a difficulty in all other theories as well as in this, for a true theory must be at least reconcilable with all well-established facts; and as he was nearly satisfied that this was a true theory, and as the facts he had stated were indisputable, he was sure the Section would feel grateful to Prof. Thomson if he would explain. Supposing each molecule to have poles, he conceived those facts might meet a physical explanation by the Dynamical theory. Prof. Thomson, in answer to Prof. Stevelly's question, if the Dynamical theory of heat, on which the new theory of solar heat is founded, could explain the strange, almost anomalous, expansion which water exhibits before freezing, remarked that, since in the act of freezing water expands, it is certain that the polar condition which the particles assume fixedly when solid is such that they keep one another farther asunder then than when turning about into all possible relative positions, as they probably do in their thermal motions when the mass is liquid and warm. It appears, then, very highly probable that, when the water is cooled towards the freezing point, the energy of these thermal motions is diminished, so that the excursions of the polar axes of the particles become confined to narrower and narrower limits, and the axes of contiguous particles begin to affect or tend towards those relative positions into which they settle in freezing. This tendency would make the particles begin to keep one another farther asunder, or make the whole mass expand, even before it freezes, when its temperature is lowered below a certain limit, and would explain the fact that water

does expand as it is cooled below 39° Fahr. After the mass is frozen, the thermal motions of or among its particles can scarcely be motions involving any excursions of their polar axes; and whatever they are, a diminution of them will again begin to produce the natural and ordinary effect of a diminution of what Sir Humphrey Davy has well called "repulsive motion;" that is, will allow the mass to contract. The Dynamical theory of heat, then, while it obviously shows the true reason of the natural and ordinary phenomenon of the contraction of a mass, whether fluid or solid, may consistently explain the contraction of liquid water as it is cooled down to 39°, its gradual expansion as it is cooled farther, its sudden expansion in freezing, and the contraction which the solid ice experiences when the lowering of temperature is continued.

Prof. Stokes addressed the Section with reference to a passage in the Report. He remarked that there was one phenomenon relating to light which was strictly analogous to, if not identical with, (he himself believed identical with,) the gradual emission of radiant heat by a body which had been warmed by exposure to radiant heat: he alluded to phosphorescence. This phenomenon was very intimately allied to another, exhibited by a solution of sulphate of quinine, by glass colored by oxide of uranium, &c., which has been termed fluorescence. In the latter phenomenon certainly the law appeared to be general, that the light emitted was of lower refrangibility than the rays affecting the medium; and the same appeared to be at least usually true in the case of phosphorescence. Dr. Draper had indeed stated that Canton's phosphorus was rendered luminous by the rays from incandescent lime after traversing a strong solution of bichromate of potash. Prof. Stokes stated that he had repeated this experiment, but had not obtained the same result, the rays in his own experiments having proved inefficient after traversing the solution. It seemed worthy of investigation to examine whether the heat emitted by a body which had been heated by rays of some particular refrangibility consisted, *in all cases, exclusively* of rays of lower refrangibility. Much progress, he conceived, would be made in our knowledge of the subject of radiant heat, if the absorbing power of several common substances, such as water, alum, &c., frequently employed in researches on heat, were determined *for each degree of refrangibility of radiant dark heat in particular.* This determination would require, first, the formation of a pure heat spectrum; second, the rendering in some manner its existence sensible. The first would require the observer to be possessed of a prism and a lens of transparent rock salt. Although recent investigations had shown, as had been anticipated, that this substance was not perfectly transparent with respect to dark radiant heat, yet, of all solid or liquid substances hitherto examined, it was by far the most nearly transparent. The most hopeful direction in which to look for ready means of rendering sensible the presence of rays of low refrangibility seemed to be their chemical effects. If some of those who were skilled in photography would turn their attention in this direction, we might soon be in possession of very

sensitive preparations, by means of which the absorbing power of various media with respect to these rays might be determined by merely interposing, any where in the path of the rays, a plate of the substance to be examined.

ON THE SURFACE TEMPERATURE AND GREAT CURRENTS OF THE NORTH ATLANTIC AND NORTHERN OCEANS.

The following communication was read before the last meeting of the British Association by Dr. Scoresby. The observations generalized upon by the author had been derived from the temperature of the ocean, chiefly at the surface, and made in the Greenland Sea, the North Sea, and a considerable belt across the North Atlantic, during a series of passages chiefly by sailing vessels between England and New York. Dr. Scoresby directed the present attention of the Section to the observations made in the last of these localities. Of the passages just noted, sixteen in number, four were performed by the author, and twelve by an American navigator, Capt. J. C. Delano, an accurate scientific observer. The observations on Surface Temperature discussed amount to 1153, gathered from about 1400. Usually Capt. Delano recorded six observations each day during the voyage, at intervals of four hours. Seven of the passages were made in the spring of the year,—two in the summer,—one in autumn,—and three in winter. Taking the middle day of each passage, the mean day at sea was found to be May 18th or 19th,—a day fortunately coincident in singular nearness with the probable time of the mean annual oceanic temperature. The author had laid down the tracks of the ship in each of the voyages on a chart of Mercator's projection, and the principal observations on Surface Temperature were marked in their respective places. The observations were then tabulated for meridians of 2° in breadth, from Cape Clear, longitude 10° W., to the eastern point of Long Island, longitude 72° W., embracing a belt of the average breadth of 220 miles, or a stretch of about 2600 miles across the Atlantic. The results were the following: 1. Highest Surface Temperature northward of latitude 40°, 74°; lowest 32°; range 39°. 2. Mean Surface Temperature, as derived from the means of each meridional section, 56°, whilst the mean atmospheric temperature for the corresponding period was 54°.2. 3. Range of Surface Temperature within each meridional section of 2°, 8½° at the lowest, being in longitude 20–22° W., and at the greatest 36°, being within the meridian of 62–64° W. 4. Up to longitude 40° the Surface Temperature never descended below 50°; the average lowest of the sixteen meridional sections being 51°.88, and the average range 11°.3. 5. In the succeeding fifteen sections, where the lowest temperature was 32°, the average lowest was 37°.1, and the average range 29°.7. This remarkable difference in the temperature of the eastern and western halves of the Atlantic passage, the author said, was conclusively indicative of great ocean currents, yielding a mean depression of the lowest meridional temperature from 51°.88 to 37°.1, or

14°.8, and producing a mean range of the extreme of temperature on the western side of almost thrice the amount of the extremes on the eastern side, or, more strictly, in the proportion of 29°.7 to 11°.3. The author drew attention to a diagram in which he had laid down along the entire belt curves showing the whole range of the lowest depressions of temperature and highest elevation, with the means at each longitude distinguished by different shading, and pointed out how the inspection of this, as well as of the tabulated results, affords striking indications of the two great currents, one descending from the Polar, the other ascending from the Tropical regions, with their characteristic changes of cold and heat. The author then proceeded to draw conclusions, showing that sometimes the cold current from the north plunged beneath the warmer current from the south. Sometimes they divided,—the colder keeping in shore along the American coast, the other keeping out, and forming the main Gulf-stream. Sometimes where they met they interlaced in alternating stripes of hot and cold water; sometimes their meeting caused a deflection,—as where one branch of the Gulf-stream was sent down to the south-east of Europe and north of Africa, and another branch sent up past the British Islands to Norway and Scandinavia, by the Polar current setting down to the east of Newfoundland. The author next proceeded to consider the uses in the economy of Nature of these great oceanic currents. The first that he noticed was the equalizing and ameliorating influence which they exercised on the temperature of many countries. Of this he gave several examples. Thus, our own country, though usually spoken of as a very variable climate, was subject to far less variations of range of temperature than many others in similar latitudes,—which was chiefly from the general influence of the northern branch of the Gulf-stream setting up past these islands. He had himself, on one occasion, in the month of November, known the temperature to rise no less than 52° in forty-eight hours, having previously descended in a very few days through a still greater range; while in these countries the extensive range between mean summer and winter temperature scarcely in any instance exceeds 27°, and in many places does not amount to nearly as much. Another advantage derived from these currents, was a reciprocation of the waters of high and low latitudes, thus tending to preserve a useful equalizing of the saltness of the waters, which otherwise, by evaporation in low latitudes, would soon become too salt to perform its intended functions. Next he pointed out their use in forming sand-banks, which became highly beneficial as extensive fields for the maintenance of various species of the finny tribes, as in the great banks of Newfoundland. Next, this commingling of the waters of several regions tended to change and renew, from time to time, the soil of these banks, which, like manuring and working our fields, was found to be necessary for preserving these extensive pastures for the fish. Lastly, by bringing down from Polar regions the enormous masses of ice which, under the name of icebergs, were at times found to be setting down towards tropical regions, they tend at the same time to ameliorate the

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great heats of those regions, and to prevent the Polar regions from becoming blocked up with accumulating mountains of ice, which, but for this provision, would soon be pushed down as extensive glaciers, rendering whole tracts of our temperate zones uninhabitable wilds.

PROTECTION AGAINST HAIL.

The second volume of the works of Arago have called attention to several points in Meteorology. In the chapter which he devotes to the subject of hail, he states, that, in 1847, two small agricultural districts of Bourgogne had lost by hail crops to the value of a million and a half of francs. Certain of the proprietors from the neighborhood went to consult Arago on the means of protecting them from like disasters. Resting on the hypothesis of the electric origin of the hail, he suggested the discharge of the electricity of the clouds by balloons communicating by a metallic wire with the soil. These projects, however, were not carried out; and in view of the doubts as to the electric origin of hail, he proposed to investigate the subject anew. He had not the time to bring out any results; but he persisted in believing in the effectiveness of the method proposed. Another subject is discussed in this volume. Arago inquires whether the firing of cannon can dissipate storms. He cites several cases in its favor, and others which seem to oppose it; but he concludes by recommending it to his successors. Whilst Arago was propounding these questions, a man not conversant in science, the poet Mery, was collecting facts supporting the view, and has since published his results. In a remarkable pamphlet entitled "Paris Futur," he concludes strongly on the efficaciousness of the firing of cannon in dissipating storms, and mentions numerous observations in support of it. He says that his attention was called to the subject in 1828, while an assistant at the "Ecole de tir" of Vincennes. Having observed that there was never any rain on the morning of the exercise of firing, he was led to examine the annals of military and revolutionary science, and he found there, as he says, facts which justified the expressions which became common, such as "Le soleil d'Austerliz," "Le soleil de Juillet," upon the morning of the revolution of July, and he concluded by proposing to construct around Paris 12 towers of great height, which he calls "tours imbrifuges," (imbrifugal towers,) each carrying 100 cannons, which should be discharged into the air on the approach of a storm.

About this time an incident occurred, which in no ways confirmed the truth of M. Mery's theory. The 14th of August was a fine day. On the 15th, the *fête* of the Empire, the sun shone out, the cannon thundered all day long, fire-works and illuminations were blazing from 9 o'clock in the evening. Every thing conspired to verify the hypothesis of M. Mery, and chase away storms for a long time. But towards 11 in the evening a torrent of rain burst upon Paris, in spite of the pretended influence of the discharge of cannon, and gave an occasion for the mobile Gallic mind to turn its attention in other directions.—*Paris Cor. of Silliman's Journal.*

CHEMICAL SCIENCE.

ON THE DEPENDENCE OF THE CHEMICAL PROPERTIES OF COMPOUNDS UPON THE ELECTRICAL CHARACTER OF THEIR CONSTITUENTS.

The following is an abstract of a lecture recently delivered before the Royal Institution, (London,) by Mr. Frankland, on the above subject:—

The lecturer first directed attention to the remarkable continuity and correlation of the natural forces, owing to which, the philosopher seeking to eliminate the effects legitimately due to each frequently experienced the greatest difficulty in separating the true results of a single force from the cognate influence of other forces. Such difficulties were more especially encountered in the manifestations of the chemical force or chemical affinity, which rarely or never acted singly and alone, but was constantly accompanied, modified, and controlled by collateral forces, which alternately exalted, depressed, or altogether inverted it. The powerful influence of cohesion and heat especially attracted the attention of Berthollet, and so impressed that profound philosopher with their potency as to lead him to ignore completely the existence of a separate chemical force. Notwithstanding the otherwise singularly ingenious and sound conclusions of this chemist, the lecturer believed that later researches had demonstrated the total denial of a distinct chemical force to be untenable. The influence of electricity upon chemical affinity was, perhaps, even still greater than that of cohesion or heat; the most powerful combinations being broken up by this agent, if its operations were favored by the two conditions—mobility of particles, (fluidity,) and conductibility of the electric current. The phenomenon of the evolution of the separate elements of a binary compound, at the opposite poles of the decomposing cell, was one of the most remarkable attending the resolution of compounds into their elements by the electrical force. This forced upon philosophers the conclusion, that such elements were oppositely electrified. Davy was the first to seize upon these facts and model them into an electrochemical theory, which, notwithstanding its defects, was at least as soundly philosophical as those which succeeded it. Davy supposed that the elements in their uncombined condition did not contain free electricity, but

that by contact they became excited. Thus, a particle of sulphur became negative when placed in contact with a particle of copper, which last was simultaneously rendered positive: the application of heat intensified the charge, until at a certain point the tension of the two electricities became so high that they suddenly re-combined, carrying with them the molecules of copper and sulphur, which were thus intimately mingled, whilst evolution of heat and light resulted from the combination of the two electricities. Ampère and Berzelius subsequently attempted to remove some of the difficulties which were encountered in endeavoring to make Davy's theory embrace all chemical phenomena. Ampère considered each element to be permanently endowed with a definite amount of one or the other electricity, being thus invariably either electro-positive or electro-negative to an extent dependent upon the intensity of the charge. Such a naturally charged molecule Ampère imagined to attract around it an atmosphere of the opposite electricity of corresponding intensity, and that, when two molecules oppositely charged were brought in contact, their atmospheres of electricity united, giving rise to the heat and light of chemical combination, whilst the original charge retained the attracting molecules in permanent union. Although this theory elucidated some points which Davy's view left unexplained, yet it would not be difficult to start several very serious objections to it: the attempted removal of these gave rise to the electro-chemical theory of Berzelius, who supposed that each element contained the two electricities, but that the one was more powerfully developed than the other, as in the case of a magnet, in which one pole, by being divided was apparently weaker than the other. In chemical combination, Berzelius imagined that one of the electricities of each element was discharged, producing the heat and light of chemical action, whilst the other was retained and served to hold the elements in combination. But these attempts of Ampère and Berzelius to improve the theory of Davy succeeded perhaps less in perfecting our views of electro-chemical phenomena than in demonstrating the necessity for much further research before these phenomena could be satisfactorily interpreted; for these theories, in which different degrees of affinity were explained by differences in the degree of electrical excitement, have been proved radically defective by the remarkable discovery of Prof. Faraday, that compounds, whose elements were united by the most dissimilar degrees of affinity, required equal quantities of electric force for their decomposition. Such defects in the attempts to account for chemical phenomena by electrical agency led Dumas and other chemists to reject altogether the idea of electro-chemical combination. Dumas regarded a chemical compound as a group of molecules connected by a single force in a manner analogous to a planetary system, and the chemical character of a compound as dependent upon the position of the separate molecules, and not upon their individual character. This view would not have received such extensive adoption, nor been the parent of such numerous and brilliant discoveries in the organic portion of the science, if it had not contained a profound truth: nevertheless, the

lecturer conceived that the total abnegation of the influence of the electrical character of elements upon the chemical properties of their compounds implied by this theory of types, was directly opposed to many of the phenomena of chemical combination, which invariably revealed such a connection. The effect of successive additions of oxygen to an electro-positive element, in gradually weakening its basic, and consequently electro-positive, qualities, and finally converting it into an acid, or electro-negative body, was well known in the case of manganese, iron, chromium, gold, &c., but the effects of the juxtaposition of two or more elements of similar electrical character had not hitherto been much studied. Granting the existence of an electrical charge associated with the molecules of matter, it was evident that such a union of atoms as that just mentioned would resemble two approximated globes similarly electrified. Now, the effect of the approximation of two such globes would be the intensification of the charge of each; and, therefore, if there were any connection between electrical and chemical character, it would be exemplified by an increased energy of affinity under such circumstances. Examples of such an approximation of atoms of similar character were not wanting, even amongst inorganic bodies: thus the compounds of chlorine with oxygen were remarkable instances of the union of like atoms; and we see in several of them the truth of the foregoing proposition fully borne out. Hypochlorus, chlorus, and chloric acids, were all distinguished by the intense energy of their affinities, and contrasted strongly with the compounds of oxygen or chlorine with electro-positive elements. The compounds of phosphorus with hydrogen also exemplified the same effect. Phosphorus, though usually regarded as an electro-negative body, was yet far more closely associated in its general character with the metals than with the metalloids; we were, therefore, entitled to regard a compound of this element with hydrogen as a juxtaposition of two similarly electrified atoms. Now, two of the compounds of phosphorus with hydrogen, viz., bin-hydride and ter-hydride of phosphorus, were remarkable for the intensity of their affinities, the one being spontaneously inflammable, and the other merely requiring a diminution of pressure, when mixed with atmospheric air or oxygen, to determine its combustion. But the influence of the electrical character of elements upon the chemical properties of their compounds was, perhaps, most strikingly seen in the behavior of the organo-metallic bodies, nearly all of which had only recently been discovered. Most of these bodies, which, in their isolated condition, consisted of two or more similarly electrified atoms, were distinguished by an intensity of affinity which was quite foreign to their proximate, or even elementary, constituents. Zinc and methyl, for instance, were neither of them distinguished for any remarkable energy of affinity in their free state; but united, as zinc-methylium, they formed a compound, whose combining energy surpassed that of all known bodies; and this behavior was shared in, also, by the corresponding compounds of zinc with ethyl and amyl. In cacodyl, stanethylium, stibethylium, and the new compounds of arsenic

with ethyl, we had additional and striking evidence of the same law; for the affinities of arsenic, tin, and antimony, were, in these compounds, exalted in a most remarkable manner by the approximation of similarly electrified atoms. These examples seemed to prove clearly the great influence of the electrical character of elements upon the chemical properties of their compounds; but further study of the subject also revealed the paramount influence of molecular structure, which modified and controlled the effects of electrical character, and limited all affinity, however heightened by electric induction.

ON CHEMICAL AFFINITY AMONG SUBSTANCES IN SOLUTION.

The following is an abstract of a paper read before the Royal Institution by Dr. J. H. Gladstone:—

Attention was first directed to the doctrine of Bergmann, that when a decomposition takes place by means of the greater electro attraction of a third body, that decomposition is complete. In opposition to this, Berthollet contended, that in all such cases of composition, or decomposition, there takes place a partition of the base, or subject of the combination, between the two bodies whose actions are opposed; and that the proportions of this partition are determined, not solely by the difference of energy in the affinities, but also by the difference of the quantities of the bodies—by their physical condition—and by that of the combination capable of being generated. Several experiments were made to show how easily elective affinity was affected by circumstances. Thus ammonia will displace alumina from a solution of the sulphate; but, on the other hand, alumina will displace ammonia when heated with the solid sulphate of that volatile base; whilst if solutions of chloride of aluminum and sulphate of ammonia be mixed and evaporated, crystals of the double sulphate ammonia alum will appear. So great is the influence exerted by these various circumstances that some have doubted whether there be a true elective affinity; but, after making every allowance for known causes, there is still a residuary phenomena to which that name is the most appropriate. Allowing then, with Bergmann, that relative degrees of affinity exist, the question arises, Is Berthollet's law also correct? It is difficult to arrive at a satisfactory answer, since it is almost impossible to eliminate other influences. Several reactions, however, were mentioned as tending to show that there is some truth in the law:—for instance, the solution of gold in hydrochloric acid upon the addition of nitrate of potash. The experiments of Bunsen on mixtures of carbonic oxide and hydrogen exploded with a quantity of oxygen insufficient for complete combustion; and those of Debus, on the precipitation of mixed hydrates of lime and baryta by carbonic acid, were explained; as also the remarkable fact, noticed by both, that the resulting products were always in certain atomic proportions to one another. But in both these cases, the first products of the chemical action are removed at once from the field: it is quite another

case when they remain free to act and react on one another. Supposing they all remain in solution, the requisite is fulfilled; but how are we to know what has then taken place? Malaguti thought to obtain an indication of this by mixing the aqueous solutions of two salts, one of which is soluble in alcohol, and the other is insoluble, and then pouring them into very strong alcohol, and analyzing the salts immediately thrown down. His results are tabulated; they are valuable, but to some extent open to objection, on account of the disturbing influence of the alcohol. The lecturer then proceeded to describe his own endeavors to arrive at a knowledge of the intimate constitution of a mixture of salts in solution by observing their physical properties, especially color. If solutions of one equivalent of nitrate of iron, and a triple equivalent of sulphocyanide of potassium, be mixed, a blood-red color results, owing to the formation of sulphocyanide of the sesquioxide of iron. The question arises, Has all the iron left the nitric acid to unite itself with the sulphocyanogen? It has not; for, on the addition of equivalent after equivalent of sulphocyanide of potassium, a deeper red is constantly obtained. The arrangement by which this deepening of color was quantitatively determined was explained, and imitated on the lecture table. The result was, that, even up to 375 equivalents, a regular increase was observed to take place more rapidly at first than afterwards, which was exhibited to the eye by the results being projected as a curve. Again: as, in the mixture of equal equivalents of the two salts, some iron still remains in combination with the nitric acid, a portion of the potassium must still remain united to the sulphocyanogen. Accordingly, the addition of more iron salt also gives a deeper color. The curve expressing the results of this experiment was a regular continuation of the curve formerly mentioned; and neither of them exhibited any of those sudden transitions which the experiments of Bunsen and Debus present. Various experiments were then performed, showing the alteration in the resulting color upon any change of any of the elements in the primary experiment; for instance, the substitution of other acids for the nitric acid, or of other bases for the potash. On the addition of a colorless salt to a colored one, there results a diminution of the color greater than the mere dilution would have produced, as was exemplified in the cases of the red sulphocyanide of iron mixed with sulphate of potash, and of the scarlet bromide of gold mixed with chloride of potassium. The lecturer accordingly drew the conclusion, that, when two salts mix without precipitation or volatilization, the acids and bases frequently, if not universally, arrange themselves according to some definite proportion, and that this depends on the relative quantity of the two salts, as well as upon the proper affinities of the substances composing them. He was unable then to enter upon the influence of heat, or of dilution in certain cases, or to add any remarks connected with double salts, or with other metals, or upon certain practical applications of these views in chemical and physiological science. The fact that we very frequently find the double decomposition of a salt to be complete, the whole

of one of its constituents being precipitated, was shown to be easily explained on the principles of Berthollet. Thus, for instance, when chromate of potash and nitrate of silver are mixed, at the first moment a division will take place, producing four salts; but one of these, the chromate of silver, is thrown down at once as a precipitate, and thus put out of the field of action. Another division of the acids with the bases must take place, producing of course more of the insoluble chromate; and so on, till at length the whole of the silver is removed. And that this is really what does take place, is rendered almost certain by the fact that wherever by an interchange of acids and bases a precipitate can be produced, that precipitate does form; and if the substance be perfectly insoluble, the whole is thrown down; this occurring in opposition to all rules of "affinity," and to all tables that Bergmann, or any other chemist, ever did or could construct. The volatility of one of the products acts in the same manner as insolubility, as is exemplified in the decomposition of carbonates by any other acid. Crystallization also is but another phase of the same phenomenon. An experiment was exhibited in illustration of this. Dilute solutions of nitrate of lime and sulphate of soda were mixed at the ordinary temperature without producing any separation of solid matter; but they were so proportioned that, upon heating the mixture, the crystallization of some sulphate of lime was determined; and when once this had commenced, it progressed rapidly, resembling in that respect the ordinary phenomena of precipitation. If in a double decomposition a far larger quantity of a sparingly soluble salt be produced at the first moment than the water can dissolve, the crystals will be formed rapidly, and will accordingly be very small in size; but should there be formed at once only just sufficient to determine a separation in the solid form, the crystals will grow gradually, and will often attain a large size. This was exemplified on the mixture of nitrate of silver with the sulphates of copper and of potash respectively. It is possible that the law of Berthollet may not be universally applicable; yet the present advanced state of science shows that not only is there, as Bergmann insisted, a true chemical affinity,—that is, a preference of one substance to combine with a certain other substance instead of a third,—but, in a great number of instances at least, this substance will combine with both according to certain proportions, whenever the whole of the affinities can be brought into play at the same time.

ON OSMOTIC FORCE.

The following is an abstract of the Bakerian lecture on the above subject, delivered before the Royal Society by Prof. Graham:—

This name was applied to the power by which liquids are impelled through moist membrane and other porous septa in experiments of endosmose and exosmose. It was shown that, with a solution of salt on one side of the porous septum, and pure water on the other side, (the condition of the osmometer of Dutrochet when filled with a saline solution and im-

mersed in water,) the passage of the salt outward is entirely by diffusion, and that a thin membrane does not sensibly impede that molecular process. The movement is confined to the liquid salt particles, and does not influence the water holding them in solution, which is entirely passive: it requires no further explanation. The flow of water inwards, on the other hand, affects sensible masses of fluid, and is the only one of the movements which can be correctly described as a current. It is osmose and the work of the osmotic force to be discussed. As diffusion is always a double movement,—while salt diffuses out, a certain quantity of water necessarily diffuses in at the same time, in exchange,—diffusibility might be imagined to be the osmotic force. But the water introduced into the osmometer in this way has always a definite relation to the quantity of salt which escapes, and can scarcely rise in any case above four or six times the weight of salt; while the water entering the osmometer often exceeds the salt, leaving it at least one hundred times: diffusion, therefore, is quite insufficient to account for the water current. The theory which refers osmose to capillarity appears to have no better foundation. The great inequality of ascension assumed among aqueous fluids is found not to exist when their capillarity is correctly observed, and many of the saline solutions which give rise to the highest osmose are indistinguishable in ascension from pure water itself. Two series of experiments on osmose were described: the first series made with the use of porous mineral septa, and the second series with animal membrane. The earthen-ware osmometer consisted of the porous cylinder employed in voltaic batteries, about five inches in depth, surmounted by an open glass tube 0.6 inch in diameter, attached to the mouth of the cylinder by means of a cup of gutta percha. In conducting an experiment, the cylinder was filled with any saline solution to the base of the glass tube, and immediately placed in a large jar of distilled water; and as the fluid within the instrument rose in the tube, during the experiment, water was added to the jar so as to prevent inequality of hydrostatic pressure. The rise (or fall) of liquid in the tube was highly uniform, as observed from hour to hour, and the experiment was generally terminated in five hours. From experiments made on solutions of every variety of soluble substances, it appeared that the rise or osmose is quite insignificant with neutral organic substances in general, such as sugar, alcohol, urea, tannin, &c.; so also with neutral salts of the earths and ordinary metals, and with chloride of sodium and potassium, nitrates of potash and soda, and chloride of mercury. A more sensible but still very moderate osmose is exhibited by hydrochloric, nitric, acetic, sulphurous, citric and tartaric acids. These are surpassed by the stronger mineral acids, such as sulphuric and phosphoric acid and sulphate of potash; which are again exceeded by salts of potash and soda, possessing either a decided acid or alkaline reaction, such as binoxalate of potash, phosphate of soda, and carbonates of potash and soda. The highly osmotic substances were also found to act with most advantage in small proportions, producing in general the largest osmose in the proportion of one-quarter per cent. of

salt dissolved. Osmose is, indeed, eminently the phenomenon of weak solutions. The same substances are likewise always chemically active bodies, and possess affinities which enable them to act upon the material of the earthen-ware septum. Lime and alumina were accordingly always found in solution after osmose, and the corrosion of the septum appeared to be a necessary condition of the flow. Septa of other materials, such as pure carbonate of lime, gypsum, compressed charcoal, and tanned sole-leather, although not deficient in porosity, gave no osmose, apparently because they are not acted upon chemically by the saline solutions. Capillarity alone was manifestly insufficient to produce the liquid movement, while the *vis motrix* appeared to be chemical action. The electrical endosmose of Porrett, which has lately been defined with great clearness by Weidemann, was believed to indicate the possession of a peculiar chemical constitution by water while liquid, or at least the capacity to assume that constitution when water is polarized and acting chemically upon other substances.

A large but variable number of atoms of water are associated together to form a liquid molecule of water, of which an individual atom of oxygen stands apart, forming a negative or chlorous radical, while the whole remaining atoms together are constituted into a positive or basylous radical; which last will contain an unbalanced equivalent of hydrogen giving the molecule basicity, as in the great proportion of organic radicals. Now, it is this voluminous basylous radical which travels in the electrical decomposition of pure water, and resolves itself into hydrogen gas and water at the negative pole, causing the accumulation of water observed there; while the oxygen alone proceeds in the opposite direction to the positive pole. Attention was also called to the fact, that acids and alkalies, when in solution, are chemically combined with much water of hydration; sulphuric acid, for instance, evolving heat when the fiftieth equivalent of water is added to it. In the combination of such bodies, the disposal of the water is generally overlooked. Osmose was considered as depending upon such secondary results of combination; that is, upon the large number or voluminous proportions of the water molecules involved in such combinations. The porous septum is the means of bringing out and rendering visible, both in electrical and ordinary osmose, this liquid movement attending chemical combinations and decompositions. Although the nature and *modus operandi* of the chemical action producing osmose remain still very obscure, considerable light is thrown upon it in the application of septa of animal membrane. Ox bladder was found to acquire greatly increased activity, and also to act with much greater regularity, when first divested of its outer muscular coat. Cotton calico also, impregnated with liquid albumen, and afterwards exposed to heat so as to coagulate that substance, was sufficiently impervious, and formed an excellent septum, resembling membrane in every respect. The osmometer was of the usual bulb-form, but the membrane was supported by a plate of perforated zinc, and the instrument provided with a tube of considerable

diameter. The diameter of the tube being one-tenth of that of the mouth of the bulb or disk of membrane exposed to the fluids, a rise of liquid in the tube, amounting to 100 millimètres, indicated that as much water had permeated the membrane and entered the osmometer as would cover the whole surface of the membrane to the depth of one milllimètre, or one-twenty-fifth part of an inch. Such millimètre divisions of the tube become degrees of osmose, which are of the same value in all instruments. Osmose in membrane presented many points of similarity to that in earthen ware. The membrane is constantly undergoing decomposition, and its osmotic action is inexhaustible. Further, salts and other substances capable of determining a large osmose are all chemically active substances, while the great mass of neutral monobasic salts of the metals, such as chloride of sodium, possess only a low degree of action, or are wholly inert. The active substances are also relatively most efficient in small proportions. When a solution of the proper kind is used, the osmose or passage of fluid proceeds with a velocity wholly unprecedented in such experiment. The rise of liquid in the tube with a solution containing one-tenth per cent. of carbonate of potash in the osmometer was 167 degrees or millimètres; and with one per cent. of the same salt, 206 degrees in five hours. With another membrane and stronger solution the rise was 863 millimètres, or upwards of 30 inches, in the same time; and as much water therefore was impelled through the membrane as would cover its whole surface to a depth of 8.6 millimètres, or one-third of an inch. The chemical action must be different on the substance of the membrane at its inner and outer surfaces to induce osmose; and according to the hypothetic view which accords best with the phenomenon, the action on the two sides is not unequal in degree only, but also different in kind. It appears as an alkaline action on the albuminous substance of the membrane at the inner surface, and as an acid action on the albumen at the outer surface. The most general empirical conclusion that can be drawn is, that the water always accumulates on the alkaline or basic side of the membrane. Hence, with an alkaline salt, such as carbonate or phosphate of soda, in the osmometer and water outside, the flow is inwards; but with an acid in the osmometer, on the contrary, the flow is outwards, or there is negative osmose, the liquid then falling in the tube. In the last case, the water outside is basic when compared with the acid within, and the flow is therefore still towards the base. The chloride of sodium, chloride of barium, chloride of magnesium, and similar neutral salts, are wholly indifferent, or appear only to act in a subordinate to some other active acid or basic substance,—which last may be present in the solution or membrane in the most minute quantity. Salts which admit of dividing into a basic subsalt and free acid exhibit an osmotic activity of the highest order. Such are the acetate and various other salts of alumina, iron and chromium, the protochloride of iron, chloride of copper and tin, chloride of copper, nitrate of lead, &c. The acid travels outwards by diffusion, superinducing a basic condition of the inner surface of the membrane and

an acid condition of the outer surface, the favorable condition of a high positive osmose. The bibasic salts of potash and soda again, such as the sulphate and tartrate of potash, although strictly neutral in properties, begin to exhibit a positive osmose, in consequence, it may be presumed, of their resolution into an acid supersalt and free alkaline base.

It may appear to some that the chemical character which has been assigned to osmose takes away from the physiological interest of the subject in so far as the decomposition of the membrane may appear to be incompatible with vital conditions, and that osmotic movements must therefore be confined to dead matter; but such apprehensions are, it is believed, groundless, or at all events premature. All parts of living structures are allowed to be in a state of incessant change of decomposition and renewal. The decomposition occurring in a living membrane while effecting osmotic propulsion may possibly, therefore, be of a reparable kind. In other respects chemical osmose appears to be an agency particularly adapted to take part in the animal economy. It is seen that osmose is peculiarly excited by dilute saline solutions, such as the animal juices really are, and that the alkaline or acid property which these juices always possess is another most favorable condition for their action on membrane. The natural excitation of osmose in the substance of the membranes or cell-walls dividing such solutions seems, therefore, almost inevitable. In osmose there is, further, a remarkably direct substitution of one of the great forces of Nature by its equivalent in another force—the conversion, as it may be said, of chemical affinity into mechanical power. Now, what is more wanted in the theory of animal functions than a mechanism for obtaining motive power from chemical decomposition as it occurs in the tissues? In minute microscopic cells, the osmotic movements, being entirely dependent upon extent of surface, may attain the highest conceivable velocity. May it not be hoped therefore to find, in the osmotic injection of fluids, the deficient link which certainly intervenes between muscular movement and chemical decomposition?

ON THE CONCENTRATION OF ALCOHOL IN SÖMMERING'S EXPERIMENTS.

Prof. Graham, before the British Association, stated that, when an open vessel is filled with a mixture of alcohol and water and exposed to the air, the alcohol goes off first and leaves the water; but if, as in Sömmering's experiments, a bladder be completely filled with dilute alcohol, the liquid will decrease in bulk, and the water pass through the membrane, leaving a much larger percentage of alcohol in the bladder. Dry membrane does not exhibit this phenomenon; for a jar, the mouth of which is covered with dry bladder, allows the alcohol to escape first. The author believed that liquids diffuse mechanically, by a kind of repulsive force of the same nature as that exhibited by gases. When common salt is added to water in a jar, membrane tied over it, and immersed in a vessel containing pure

water, diffusion takes place in quantity which has a relation to the percentage of salt dissolved. Alcohol, however, exhibits an anomaly in this respect; for the quantity of alcohol which diffused itself through the membrane, when 5 per cent. of alcohol was present in the liquid, was not increased when the percentage of alcohol was 10, 15, or 20. The phenomenon indicates a sifting or separating power to reside in membrane, and introduces a third element, in addition to diffusion and osmose, into the discussion of the permeability of membranous septa. The author believed that Sömmering's experiment was an instance of arrested diffusion where more than 5 per cent. of alcohol was present. The action has some resemblance to the separating and secreting power of cells in the living organism, and may prove of great physiological interest, particularly if the action should be found to extend to albumen and other organic substances.

Prof. Faraday considered the latter part of the paper exceedingly important, and expressed a wish that Prof. Graham would give his reasons for believing that liquids diffused, owing to a repulsion between the liquid particles. Might not the attraction of the surrounding medium be wholly or partly the cause? In answer to this, Prof. Graham stated that the phenomena characteristic of gaseous diffusion might be explained by an attractive as well as a repulsive force. In the diffusion of liquids, the same analogies were observed, as also the same intensity of action. From a bottle containing solution of alum the sulphate of potash goes off first, and sulphate of alumina remains. Again: sulphurous acid and chloride of sodium may be boiled together, and no hydrochloric acid is given off; but mix them in the diffusion vial, and hydrochloric acid is given off, whilst sulphite of soda remains. Experiments on this subject are being accumulated by the author, and he sees every reason to consider that, since gaseous diffusion can be most clearly explained by the repulsive view, liquid diffusion, so analogous to it, should be likewise expressed.

RESEARCHES ON CHEMICAL AFFINITY.

Marguerite, of Paris, has been engaged in some new experiments touching the chemical affinities, and he revives the oft-debated question, which consists in defining and explaining the manner of grouping which the elements of two salts, dissolved in the same liquid, will adopt. Every salt being formed of an acid element and a basic element, it may be asked whether, after the dissolution and the mixture of the elements, they retain their original association, or, if the mixture occasions a double dissolution, they are more or less completely exchanged. When one of these possible combinations is insoluble, Berthollet's law announces it will be formed, and experience shows it does form. If, for example, the experimenter dissolves separately nitrate of lime and sulphate of potassa, the mixture of the two solutions will contain every thing that is necessary to form the nitrate of potassa and the sulphate of lime; and as the latter is very little soluble, it will be precipitated in abandoning the other elements which,

in the liquid, necessarily constitute themselves in the state of nitrate of potassa. But when the two salts primitively chosen do not bring to the mixture the elements of an insoluble composite, Berthollet's law ceases to be applicable, and a great deal of uncertainty prevails about the composition of the resulting dissolution. It is true, that in concentrating the liquid, and crystallizing it, the least soluble of the four possible combinations appears; but as, acting in this way, we return to Berthollet's law, we can deduce no conclusion relative to what remains in the liquid before the crystallization. M. Marguerite holds that in this case the four combinations coexist, and he lays down, parallel with Berthollet's law, this principle: When by the mixture of two salts, which have satisfied the law of insolubility, a salt may be formed more soluble than the least soluble of them, the action of water determines its formation within certain limits. It is, consequently, the affinity of the dissolvent, or the force of solubility, which groups the elements, according to its tendency to form a combination more soluble than the least soluble.

ON THE EXTRACTION OF METALS BY MEANS OF THE BATTERY.

In the course of his researches on the electrolysis of metallic combinations, Professor Bunsen was led to determine the causes which most influence the separation of the metal. These causes are two in number, the principal of which is owing to what he calls the density of the current; the other cause dwells in the greater or less concentration of the electrolyte or liquid to be decomposed. The maximum of effect is obtained with the most dense fluid and the most concentrated solution. The word *density*, applied to a force, necessarily excludes the idea of weight or volume. Professor Bunsen means, by this word, the concentration to a single point of the electrical undulations, in a manner analogous to the concentration of luminous or calorific rays in the focus of a concave mirror.

Let us take, for example, a charcoal crucible, in communication with the positive pole of the battery, and place in it a small capsule of glazed porcelain containing the liquid to be decomposed; the space between the crucible and the capsule is filled with hydrochloric acid, and the liquid of the small capsule is put in communication with the battery by means of a thin sheet or wire of platinum. The current is then established between a large surface, the charcoal crucible, and a fine platinum wire, in which it is concentrated; the effects are added in this direction, and the fluid becomes capable of overcoming affinities which have hitherto resisted powerful batteries. The apparatus described is placed in a porcelain crucible, which is kept warm in a sand bath. Chromium and manganium are thus separated with the greater facility from their chloruretted solutions, provided that the negative pole is very small and the saline solution very concentrated; if not, we may, at will, obtain hydrogen, peroxide or protoxide of chromium, or chromoso-chromic oxide. When the galvanic deposit is formed only of these oxides, it is sufficient to add solid mono-

chloride of chromium to obtain metallic chromium. In this state the chrome is chemically pure; it presents the appearance of iron, but it is less alterable by humid air. Heated in the air, it is converted into sesquioxide. It resists nitric acid even when boiling. The density of galvanic chromium coincides with the density deduced from the atomic volumes, and does not differ much from the known density. These facts regard only the metal prepared with one of the modifications of chloride of chromium; they leave completely undecided the question as to whether the chromium of the green chloride is identical with that of the blue. Professor Bunsen intends to study this point. On diminishing the current, the metal ceases to be deposited, and in its place appears a black powder, not crystalline, anhydrous, formed of protoxide and sesquioxide of chromium. Professor Bunsen obtained sheets of chromium of more than 50 square millimètres' surface; these sheets were friable, and presented a perfect polish on the side which had been in contact with the platinum. Manganium was obtained in the same manner. The learned chemist of Heidelberg thus prepared very friable plates of more than a 100 square millimètres' surface; these plates were oxidized in humid air almost as readily as potassium.

To reduce barium and calcium, a greater density of current is required. These metals are taken in the state of chloride, reduced to concentrated solution, and acidulated with hydrochloric acid. The boiling liquid is poured into the polished porcelain capsule, and an amalgameter platinum wire, communicating with the battery, is introduced. Calcium is deposited on the platinum wire as a gray layer, which is easily detached, and contains a little mercury. In presence of water or humid air, this amalgam of calcium oxidizes rapidly with disengagement of hydrogen; it burns with brilliancy when heated.

The precipitation of the calcium is effected only with difficulty; in consequence of its oxidizability, this metal is converted into lime, which covers the electrode, and intercepts the current. To obtain an appreciable quantity of this product, we can do nothing better than frequently remove the quite dry gray layer, and amalgamate again the platinum wire before returning it into the chloride.

Barium is more easily extracted; chloride of barium, in powder, is reduced into a paste by means of water acidulated with hydrochloric acid; it is heated to 212° in a water bath, and the current is established. The amalgam of barium which is thus produced is solid, of a silvery white, and very crystalline. Exposed to humid air, it becomes heated, and is converted into hydrate of baryta. Placed in a charcoal boat, and heated in a current of hydrogen, it abandons the mercury, and the residue is composed of porous barium, presenting here and there brilliant metallic particles.—*Poggendorff's Annalen.*

ON TWO PROCESSES FOR THE PREPARATION OF ALUMINUM AND A NEW FORM OF SILICIUM, BY M. DEVILLE.

Aluminum, says M. Deville, in a recent report to the French Academy, of which the most common clays contain about 25 per cent. of their weight, is eminently suited to become a commonly used metal. I have not hitherto published the methods which I have used to produce it, for they required to be confirmed by additional experiments. I will now, however, state, that all I announced at first has been confirmed since I have been able to procure larger quantities of aluminum. The medals which I have had struck, and the plates which I now present to the Academy, have suffered no alteration from the air ; some small ingots have been constantly handled for months without losing their brilliancy. In fact, this substance is so completely inoxidizable that it resists the action of the air in a muffle heated to the temperature at which gold is assayed ; lead burns and litharge melts at a heat which takes no effect upon aluminum. If this metal were alloyed by lead, it evidently might be cupelled.

Aluminum conducts electricity eight times better than iron ; consequently as well as, if not better than, silver. The place which should be given to aluminum among metals, according to the principle of M. Thénard's classification, should remove it from magnesium, zinc and manganese, where it now is.* It must form the type of a very natural group, composed besides itself of chromium, iron, nickel and cobalt. They have one character in common, to which I attach the greatest importance in a theoretical point of view—they are unattackable by weak or concentrated nitric acid, in the presence of which they become *passive*. This *passiveness*, very powerful in aluminum and chromium, whose protoxides (if aluminum possesses any) have an ephemeral existence, is only manifested by iron when in concentrated nitric acid, in which the production of protoxide is impossible. It is only seen very weakly in nickel and cobalt, whose sesquioxides are unstable and difficult of combination. The two metals lead to manganese.

Aluminum, like iron, cannot be alloyed with mercury, and scarcely takes the least trace of lead. It gives, with copper light, very hard and very white alloys, even where there is 25 per cent. of copper in the mixture. It is characterized by forming with charcoal, and especially with silicium, a gray, granular and brittle casting, crystallizable with the greatest facility. When broken it forms angles, which appear to be right angles. When this mixture is attacked by hydrochloric acid, the odor of the hydrogen indicates the presence of charcoal. But what it especially contains is silicium, which separates from it in a pure state when we prolong the action

* Zinc should be placed with magnesium. In the first place, zinc decomposes water at 212 deg. F. ; then, contrary to the general opinion, pure oxide of zinc is irreducible by hydrogen, in the midst of which it volatilizes, forming artificial cadmia, an assemblage of crystals in which may be perceived the rhombohedral form of oxide of zinc.

of concentrated, boiling hydrochloric acid. It appears to me evident that silicium exists in aluminum castings in the same state as carbon in gray cast iron, a state as yet but little understood, but which my researches in aluminum will enable me, I hope, to elucidate in some degree.

This silicium is in brilliant metallic plates, similar to platinum, and under this form it differs considerably from the silicium of Berzelius. However, I do not think that this silicium is the real metal; on the contrary, I think that this new form of silicium is to ordinary silicium what graphite is to charcoal. This body possesses, with a more complete unalterability, all the chemical properties which Berzelius attributes to the residue of the incomplete combustion of ordinary silicium. Thus, to give an idea of this indifference to the action of the most powerful re-agents, I will mention, that the new silicium has been heated to whiteness, without changing its weight, in a current of pure oxygen; that it resisted the action of hydrofluoric acid, and only dissolved in a sort of *aqua regia*, formed of hydrofluoric acid and nitric acid. *Potassa fusa* transformed it into silicia, but the operation took a very long time. It conducts electricity like graphite.

The aluminum castings from which I extracted the silicium contained more than 10 per cent. It appears that, for the preparation of this casting, the silicium must be in a nascent state at the moment of combination; for aluminum, melted in an earthern crucible, attacks the sides, frees the silicium, but does not unite with it: * the metal preserves all its malleability, and a chocolate-colored powder is found in the crucible, which is nearly identical with the silicium of Berzelius. We shall see, farther on, that this casting is the first product which results from the action of the battery on chloride of aluminum and chloride of silicium, which always exist together in the impure matters which are subjected to decomposition.

I shall only give in this communication two methods of operating; the two which I know well, and have often employed.

1st. *Process with Sodium.*—Take a large glass tube of three or four centimeters in diameter, introduce into it 200 or 300 grms. of chloride of aluminum, which are well isolated between two plugs of asbestos. By one extremity of the tube, dry, pure hydrogen is introduced. Heat the chloride of aluminum in this current of gas with charcoal, so as to drive out the hydrochloric acid, chloride of silicium and chloride of sulphur, with which it is always impregnated. Then introduce into the tube some boats as large as possible, containing each a few grms. of sodium crushed between two sheets of very dry blotting paper. The tube being full of hydrogen, the sodium is melted and the chloride of aluminum is heated; it distils and decomposes with an incandescence which can be moderated, and even prevented, if desired. The operation is terminated when all the sodium has disappeared, and the chloride of sodium formed has absorbed sufficient chloride of aluminum to be saturated with it. The aluminum

*I now prepare infusible and unattackable crucibles with calcined alumina, rendered plastic by means of gelatinous alumina.

is then in a double chloride of aluminum and sodium, a very fusible and volatile compound. The boats are removed from the glass tube, introduced into a large tube of porcelain fitted to an adapter, and traversed by a current of hydrogen, quite dry and free from air. It is heated to bright redness: the chloride of aluminum and sodium distils without decomposition: it is collected in the adapter, and after the operation all the aluminum will be found in each boat collected in one, or at most two large globules. They are washed in water, which again removes a little of a salt with an acid reaction and brown silicium. To form one button of all these globules, after having cleaned and dried them, they are introduced into a porcelain capsule, into which is put a little of the product distilled in the previous operation; viz., some of the double chloride of aluminum and sodium. The capsule being heated in a muffle to a temperature approaching the point at which silver fuses, all these globules will be seen to reunite into one button, which is allowed to cool, and washed. The melted metal must remain in a covered porcelain crucible until the vapors of chloride of aluminum and sodium, with which the metal is always impregnated, have entirely disappeared. The metallic button is found enveloped with a thin pellicle of alumina, proceeding from the partial decomposition of the small quantity of distillate. It will be understood that sodium may be replaced by its vapor, which is produced easily, and the aluminum will be obtained economically even by employing an alkaline reducing agent.

2d. *By the Battery.*—It appeared to me impossible to obtain aluminum by the battery in aqueous liquids. I should believe this to be an absolute impossibility if the brilliant experiments of M. Bunsen on the production of barium did not shake my conviction. Still, I may say that all processes of this species which have recently been published for the preparation of aluminum have failed to give me good results.

It is by means of the double chloride of aluminum and sodium, ($Al^2 Cl^3 Na Cl$,)* of which I have already spoken, that this decomposition is affected. The bath of aluminum is prepared with two parts, by weight of chloride of aluminum, with the addition of one part of dry and pulverized common salt. The whole is mixed in a porcelain capsule heated to about 392° F. The combination is effected with disengagement of heat, and a liquid is obtained which is very fluid at 392° F., and fixes at that temperature. It is introduced into a tube of polished porcelain, which is to be kept at a temperature of about 392° F. The negative electrode is a plate of platinum, on which the aluminum mixed with common salt is deposited, under the form of a grayish crust. The positive electrode is formed by a perfectly dry, porous vessel, containing melted chloride of aluminum and sodium, into which is placed a cylinder of charcoal,† which conducts elec-

* This interesting substance, which represents spinel ruby with a base of soda, in which chlorine replaces the oxygen, is the type of a great number of analogous bodies which I am now studying, for the purpose of comparing them with the mineral oxides, from which they only differ in chlorine being substituted for oxygen.

† The densest charcoal is rapidly dissolved in the bath, and becomes pulverulent; hence the necessity for the porous vessel.

tricity into it. The chlorine is thus removed with a little chloride of aluminum, proceeding from the decomposition of the double salt. This chloride would volatilize, and be entirely lost, if some common salt were not in the porous vessel. The double chloride becomes fixed, and the vapors cease. A small number of elements (two are all that are absolutely necessary) will suffice for the decomposition of the double chloride, which presents but little resistance to electricity.

The platinum plate is removed when it is sufficiently charged with the metallic deposit. It is suffered to cool, the saline mass is rapidly broken off, and the plate replaced in the current. The crude matter removed from the electrode is melted in a porcelain crucible enclosed in an earthen crucible. After cooling, it is treated with water, which dissolves a great portion of the common salt, and a gray metallic powder is obtained, which is formed into a button by several successive fusions, using as a flux the double chloride of aluminum and sodium.

The first portions of metal obtained by this process are almost always brittle; it is of aluminum castings that I now speak. However, we can obtain quite as beautiful a metal with the battery as with sodium, but must employ a purer chloride of aluminum. And in fact, in this last process, we remove by means of the hydrogen the silicium, sulphur, and even the iron, which passes into the state of fixed protochloride at the temperature at which the operation is performed; whereas all the impurities remain in the liquid which is decomposed by the battery, and are removed with the first portions of the metal which are reduced.—*Comptes Rendus No.* 7, 1854.

ON THE METAL GLUCINUM.

While Deville has been occupying himself with aluminum, his assistant, M. Debray, has been studying glucinum, which metal (as well as aluminum) M. Wöhler was the first to obtain separate, although in an impure state, if we may judge from the properties of the metal mentioned by M. Debray. According to this chemist, glucinum is lighter than aluminum; its specific gravity is 2.1. It looks like zinc, but is less fusible, non-volatile, unalterable at the ordinary temperature, and oxidizes on the surface at the blow-pipe temperature without affording the phenomena of ignition produced under the same circumstances by zinc and iron. Concentrated nitric acid attacks it only when hot, and diluted acid under no circumstances. Chlorohydric and sulphuric acids, even when diluted, dissolve it, disengaging hydrogen. Potassa dissolves it, even cold; ammonia is without action.

DEPOSITION OF ALUMINUM AND SILICIUM.

Mr. Gore, of Birmingham, has succeeded in depositing aluminum and silicium upon copper by the electrotype process. To obtain the former,

he boils an excess of dry hydrous alumina in hydrochloric acid for one hour; then, pouring off the clear liquid, adds one-sixth its volume of water. In this mixture was set an earthen porous vessel, containing sulphuric acid, diluted with twelve parts of water, and with a piece of amalgamated zinc plate in it. In the chloride of aluminum solution was immersed a plate of copper, of the same amount of immersed metallic surface as that of the zinc, and connected with the zinc by a copper wire. The whole was then set aside for some hours, and, when examined, the copper was found coated with a lead-colored deposit of aluminum, which, when burnished, possessed the same degree of whiteness as platinum, and did not readily tarnish, either by immersion in cold water or by the action of the atmosphere, but was acted on by sulphuric and nitric acids, whether concentrated or dilute. If the apparatus is kept quite warm, and a copper plate much smaller than the zinc plate is employed, the deposit appears in a very short time—sometimes in half a minute; if the chloride solution is not diluted with water, the deposit is equally, if not more, rapid.

The author has also succeeded in obtaining a quick deposit of aluminum, in a less pure state, by dissolving common pipe-clay in boiling hydrochloric acid, and using the clear liquor undiluted in place of the above-mentioned chloride. Similar deposits were obtained from a strong aqueous solution of acetate of alumina, and from common alum, but more slowly. With each of the solutions named, the deposit was hastened by putting from one to three small Smee's batteries in the circuit.

To obtain the deposit of silicium, monosilicate of potash (prepared by melting together one part silica with two and one-fourth parts carbonate of potash) was dissolved in water, in the proportion of forty grains to one ounce measure, proceeding as with aluminum, the process being hastened by interposing a Smee's battery in the circuit. With a very slow and feeble action of the battery, the color of the deposited metal closely resembled that of silver.

ON THE FORMATION OF VESSELS OF GOLD BY THE AID OF PHOSPHORUS.

The property of phosphorus, of precipitating certain metals from their solution, has long been known; and gold is among the number. M. Levol has used this process in forming gold vessels, so useful in chemical research. He takes the perchloride of gold, and places in it, at the ordinary temperature, some phosphorus, moulded of a form convenient to serve as a nucleus for the vessel of gold. To give the phosphorus the desired shape, it is melted in a water-bath near 60° C. in temperature, within a vessel of glass having the form required. After cooling it, the phosphorus is taken out solid from its envelope, breaking it if it be necessary. The precipitation of the gold or the construction of the vessel is then begun; and it finally remains only to remove the phosphorus by remelting it and

washing, by the aid of boiling nitric acid, until the last traces are removed.
—*Silliman's Journal.*

ON THE ARTIFICIAL PRODUCTION OF THE DIAMOND.

During the year 1853, M. Desprétz announced to the French Academy that he had succeeded, by long-continued voltaic action, in depositing crystallized carbon, having all the properties of the diamond.* These conclusions, so extraordinary, have induced Desprétz to review the whole subject, in a communication recently presented to the French Academy. The facts seem indisputably to be, that carbon was deposited at one of the terminal poles of the battery, in a crystallized form—that of the *truncated octohedra;* also in amorphous grains, and in transparent plates. It must be borne in mind, that although the quantity of carbon so deposited was sufficient for testing and experiment, yet the crystals were microscopic, the entire mass having the form of a powder. The charcoal operated upon by the battery was prepared from crystallized sugar candy, and was free from every trace of mineral substance. The products of the deposition M. Desprétz submitted to Gauden, famous for his experience in the cutting and polishing of gems. Gauden, after trying the powder in every possible manner, gave it as his unhesitating conclusion, that no other powder than that of the diamond could have cut and polished diamonds and rubies as that did, "and appears to confirm, in the clearest manner, the existence on the terminal battery wires of true implanted diamonds."

The result, therefore, of Desprétz's experiments may be summed up in his own words as follows:—

"Have I obtained crystals of carbon which can be isolated and weighed, and of which the index of refraction and the angles of polarization may be determined? Certainly not. But I have simply produced, by the arc of induction, and by weak galvanic currents, carbon crystallized in *black octohedra, in colorless translucent octohedra, in colorless and translucent plates*, the whole of which had the *hardness* of the powder of the diamond, and which disappeared in combustion without leaving any perceptible *residue.*"

INFLUENCE OF BISMUTH ON THE DUCTILITY OF COPPER.

There has recently been exported from Australia a black copper in ingots, possessing some peculiar properties. Although of a high percentage, the color is bronze; it is but little ductile; the fracture is loose and crystalline, which may be removed by refining in the ordinary methods.

M. Levol, Assayer of the Mint at Paris, has analyzed this copper before and after refining, with the following results:—

* See Annual Scientific Discovery, 1854, page 241.

	Crude.	*Refined.*
Copper,	99.4000	99.4800
Sulphur,	0.3140	
Lead,		0.3620
Silver,	0.1000	0.1000
Bismuth,	0.1440	0.0480
Gold,	0.0008	0.0008
Tin,	trace,	
Antimony,	"	
Loss,	0.0411	0.0089

The lead, with a trace of arsenic, proceeded from the process of refining; and it is found, by experiment, that the small proportions of antimony, arsenic, gold, silver and lead, do not explain the want of ductility of the copper. The bismuth, then, only one-third of which had resisted oxidation, is the sole cause of the loss of ductility. M. Levol has proved the correctness of this conclusion by preparing different alloys. It is remarkable that bismuth, which has so many points of resemblance to lead, should be so different in the above respect. It is important to examine for bismuth the coppers of commerce, in order to search out the cause of the peculiar mechanical and chemical qualities often found even in copper of excellent appearance.

RESEARCHES ON FLUORINE.

The following paper on fluorine has been read before the French Academy by M. Fremy:—

Some years since M. Louyet announced to the Academy several important facts respecting fluorine, hydro-fluoric acid, and the fluorides. According to M. Louyet, fluoride of mercury, heated in tubes of fluoride of calcium, was decomposed by dry chlorine, and gave fluorine; anhydrous hydro-fluoric acid prepared by the method mentioned by M. Louyet did not attack glass; and, moreover, the equivalent of fluorine determined by Berzelius should be replaced by a new number.

Not having considered the experiments of Louyet altogether satisfactory, I determined, says M. Fremy, to submit the whole to a careful examination. Following, in my experiments, such men as Gay-Lussac, Thenard, Berzelius, and Davy, I could not anticipate that any fortunate scientific accident might lead me to the immediate discovery of fluorine; but I knew that a general study of the fluorides would, under any circumstances, be very interesting to scientific men; it would complete the history of a series of compounds, hitherto but little known, and which, notwithstanding, play an important part in geological phenomena; it might indicate the direction which should be followed to attain the discovery of fluorine. This hope has sustained me through the lengthy work whose principal results I am about to describe.

The first part of my memoir relates to the preparation of pure anhydrous hydrofluoric acid. I prepare this acid by a new method, by submitting to distillation, in a platinum still, hydrofluate of fluoride of potassium.

Anhydrous hydrofluoric acid, when thus obtained, is gaseous at the ordinary temperature, but may be condensed by a mixture of ice and salt. It has then the appearance of a very fluid liquid, volatilizing when removed from the refrigerating mixture, acting very powerfully on water, diffusing in the air white fumes, whose intensity may be compared to those of fluoride of boron. Contrary to M. Louyet's assertion, anhydrous hydrofluoric acid attacks glass rapidly.

I have likewise obtained anhydrous hydrofluoric acid by decomposing in a platinum tube, by means of dry hydrogen, fluoride of lead, which I had placed in a charcoal boat, so as to avoid the action on the platinum of the reduced lead.

To avoid all the errors made by my predecessors in the study of impure fluorides, and in endeavors to isolate fluorine, I have always used, in my investigations, an acid obtained from an absolutely pure, crystallized hydrofluate of fluoride of potassium. I have thus obtained sometimes new fluorides, sometimes fluorides whose characters had been given by Berzelius.

Thus my memoir contains a complete study of the fluorides of zinc, iron, and lead, which I obtained in a crystallized state. I have produced protofluoride of tin in very clear and voluminous prisms. I have likewise obtained bifluoride of mercury in well-defined crystals.

Fluoride of silver, which was considered uncrystallizable, may, on the contrary, be deposited from a concentrated solution in crystals, whose form presents the greatest regularity.

I shall now give some of the consequences resulting from this general study of the fluorides.

All the fluorides which I have analyzed have been obtained directly by uniting the pure acid with the anhydrous or hydrated metallic oxides.

Hydrofluoric acid does not react on all the oxides which are attacked by hydrochloric acid. Thus, I found it impossible to combine hydrofluoric acid with auric acid and peroxide of platinum; finding that in this case hydrofluoric acid behaved like an oxyacid, I endeavored to ascertain whether hydrofluoric acid, which had been long called *fluoric acid*, did not in reality contain oxygen. These experiments, which presented almost insurmountable difficulties, are described in my memoir. I shall here only mention that they confirmed the constitution of hydrofluoric acid admitted by all chemists, and that they give, in my opinion, the character of a rigorous demonstration to it, which has hitherto been wanting. The result of my researches is, that the fluorides should be divided into three classes, and each of these classes forms a collection of important general properties.

The first class comprehends the acid fluorides or hydrofluates of fluorides; these compounds are very easily formed, heat decomposes them, and

when they are anhydrous they give neutral fluorides and pure hydrofluoric acid; in many experiments they may replace hydrofluoric acid. I have employed the salt of potassa for the production of a new organic compound, which is somewhat interesting; I speak of the hydrofluoric ether from common alcohol. I prepare this ether by submitting to distillation, in a platium apparatus, a mixture of sulphovinate and hydrofluate of fluoride of potassium. I thus obtained gaseous hydrofluoric ether, which, in its general properties, resembles the corresponding compound of wood-spirit, discovered, as is well known, by MM. Dumas and Peligot.

The second class is composed of neutral and hydrated fluorides: these bodies are characterized by the ease with which they are decomposed into oxides and hydrofluoric acid, when we endeavor to remove the water which enters into their composition; they behave exactly like real hydrofluates. Thus, crystallized fluoride of silver, which belongs to the class of hydrated fluorides, disengages hydrofluoric acid, and produces oxide of silver when dried even *in vacuo;* when hydrated fluoride of silver is heated, it disengages hydrofluoric acid and oxygen, and leaves a residue of very pure silver; in this case, then, it acts like a hydrofluate of oxide of silver. Fluoride of mercury, which is likewise hydrated, is decomposed by heat in the same manner as the preceding salt, disengaging hydrofluoric acid, mercury and oxygen.

The third class comprehends the anhydrous fluorides. These salts are undecomposable by heat, and may be, according to the nature of the metal which they contain, decomposed by oxygen, hydrogen, chlorine, sulphuret of carbon, and steam.

I confess that I attach great importance to this division of the fluorides into three classes; it is because they were not aware of it, that the observers who have preceded me have often committed serious mistakes in the study of the fluorides. Thus M. Louyet thought that he could isolate fluorine by decomposing fluoride of mercury by chlorine with heat; as fluoride of mercury belongs to the second class, and is hydrated, it behaves in all its reactions like a hydrofluate. The gas of M. Louyet was consequently a simple mixture of oxygen and hydrofluoric acid.

After having studied and classified the principal fluorides, my attention naturally turned to those which, from their nature, might lead to the preparation of fluorine.

I first carefully studied the fluorides formed by the difficult oxidizable metals, hoping that by the action of heat, or some other agent, they might disengage fluorine. My researches in this direction have not given any satisfactory result.

In fact, I found, to my great surprise, that hydrofluoric acid would not combine either with the oxides of gold or of platinum.

Fluoride of silver, when hydrated, behaves like a hydrofluate, and, with heat, only disengages oxygen and hydrofluoric acid; when anhydrous, it is undecomposable.

Fluoride of mercury does not exist in the anhydrous state; and when hydrated, it produces, by the action of heat, oxygen and acid vapors.

We must therefore abandon the attempt to obtain fluorine from these fluorides. I was then led by a series of experiments, which it is impossible to describe in this abstract, but which are all given in the memoir, to subject the anhydrous fluorides to powerful decomposing agents.

Guided by some experiments which I am at this time making with M. Ed. Becquerel, in which chloride of calcium, in fusion, is very rapidly decomposed by the battery, I first subjected the fused anhydrous fluorides, such as those of potassium, lead, and calcium, to an electric current. The decomposition was easily effected; I saw a gas disengaged at the positive pole, which powerfully attacked platinum. But the many difficulties surrounding this experiment have hitherto prevented me from collecting the gas thus disengaged, so as to be able to study it properly.

Sulphur acts under the influence of heat on a certain number of anhydrous fluorides, replacing the fluorine; but combinations of fluorine and sulphur are then formed, which will be studied in another work.

The action of chlorine on the anhydrous fluorides, especially on fluoride of calcium, gave me important results. All my experiments were made in platinum tubes, which were not attacked at a red heat by chlorine. The gas was dried with the greatest care by several tubes of anhydrous phosphoric acid, so as to avoid the rapid action of steam on the fluorides. I found that at a white heat dry chlorine very slowly decomposes fluoride of calcium, and disengages a gas which powerfully attacks glass, and which appeared to be fluorine. Oxygen, passing at a white heat over fluoride of calcium, decomposes it more quickly than chlorine, and produces, as in the preceding experiment, a gas which attacks glass.

Such is a summary of my experiments on the fluorides; but I shall not consider my task complete until I have really isolated a body of which I have hitherto merely caught a glimpse.

EXPERIMENTS ON COPPER AND COPPER SHEATHING.

For the purpose of experiment, M. Bobierre has made with metals, either pure or impure, ingots of bronze of a cylindrical form by castings in sand, having a height of forty centimeters and weighing twenty-five kilogrammes. Portions for analysis were taken from different parts of the ingots, both from the surface and interior. The central parts in all cases contained less tin than the surface. For example, in the alloy of ninety-seven copper and three of tin, the richness in tin for the tin parts had the ratio of 1 to 3.97. On adding to the alloy one per cent. of zinc, the homogeneity was much increased, the ratio becoming 1 to 1.45.

Under Louis XIV., the cannon were of a better quality than those of the present time; zinc was mixed with the metal in the condition of *brass*. The trials made in our time have failed, because the zinc was introduced

directly into the alloy while in fusion, in which case the zinc is burned off, and forms no combination with the fused metal.

The following are conclusions arrived at by M. Bobierre, as the result of his experiments, respecting the durability of copper-sheathing :—

1. When unalloyed copper is employed, the presence of arsenic appears to hasten its destruction.

2. All bronzes which appear to have stood well contained from four and one-half to five and one-half per cent. of tin, that quantity being necessary to form a homogeneous alloy. When the percentage of tin is only 2.5 to 3.5, which is very frequently the case, no definite alloy is produced, and the mass is of unequal composition, and, being unequally acted upon, is soon destroyed.

3. When impure copper is employed, the alloy is never homogeneous, and is unequally acted upon in consequence. We thus see that the so frequent destruction of the sheathing of copper-bottomed vessels arises from the tendency to use inferior brittle copper, and, by diminishing the proportion of tin, to economize the difference between the price of that metal and copper, at the same time that the cost of rolling is also less, in consequence of the greater softness of the poor alloy.

Bobierre thinks that the addition of a very small portion of zinc very much improves the bronze, by producing a more perfect and uniform distribution of the positive metals, and consequently a much more definite alloy.—*Comptes Rendus.*

OBSERVATIONS, ECONOMICAL AND SANATORY, ON THE EMPLOYMENT OF CHEMICAL LIGHT FOR ARTIFICIAL ILLUMINATION.

The following paper has been read at the Royal Institution, London, by Dr. E. Frankland :—

There are two principal sources of artificial light, viz., electricity and the chemical force; the latter, however, has been, and still is, the only practical source of artificial light. Although light can be thus obtained by the chemical action of substances belonging to all three kingdoms, yet closer observations demonstrate that the illuminating effect from animal and mineral bodies is primarily derived from the vegetable kingdom; every plant being an apparatus for the absorption and concentration of light and heat from the solar rays, and for the retention of those forces during its passage through the subsequent stages in the formation of vegetable fuel. Until the commencement of the present century, artificial light was derived almost exclusively from the animal kingdom; but the great economy attending its immediate production from our vast stores of vegetable fuel is becoming more and more apparent, and in fact is so generally admitted as to render more than a mere allusion to it, and a glance at the following table, unnecessary.

Table showing the comparative cost of light from various sources, each equal to 20 *sperm candles burning* 120 *grains per hour each, for* 10 *hours* :—

	s.	d.
Wax,	7	2½
Spermaceti,	6	8
Tallow,	2	8
Sperm oil, (Carcel's lamp,)	1	10
London gases,	0	4¼
Manchester gas,	0	3
Another London gas,	0	2¼

We will, therefore, confine our attention principally to the light produced from vegetable fuel, in considering the economical and sanatory bearings of artificial light. The production of artificial light depends upon the fact that at certain high temperatures all matter becomes luminous. The higher the temperature, the greater the intensity of the light emitted. The heat required to render matter luminous in its three stages of aggregation differs greatly. Thus solids are sometimes luminous at comparatively low temperatures, as phosphorus and phosphoric acids. (A jet of flame produced by the fusion of these substances was exhibited, and the temperature shown to be quite inadequate to the ignition, or even scorching, of the finest cambric or gun-cotton.) Usually, however, solids require a temperature of 600° or 700° F. to render them luminous in the dark, and must be heated to 1000° F. before their luminosity becomes visible in daylight. Liquids require about the same temperature. But to render gases luminous, they must be exposed to an immensely higher temperature; even the intense heat generated by the oxyhydrogen blowpipe scarcely suffices to render the aqueous vapor produced visibly luminous; although solids, such as lime, emit light of the most dazzling splendor when they are heated in this flame. Hence, those gases and vapors can only illuminate which produce or deposit solid or liquid matter during their combustion. This dependence of light upon the production of solid matter is strikingly seen in the case of phosphorus, which, when burned in chlorine, produces a light scarcely visible, but, when consumed in air or oxygen, emits light of intense brilliancy; in the former case the *vapor* of chloride of phosphorus is produced, in the latter solid phosphoric acid. Several gases and vapors possess this property of depositing solid matter during combustion, but a few of the combinations of carbon and hydrogen are the only ones capable of practical application; these latter compounds evolve during combustion only the same products as those generated in the respiratory process of animals, viz., carbonic acid and water. The solid particles of carbon which they deposit in the interior of the flame, and which are the source of light, are entirely consumed on arriving at its outer boundary; their use as sources of artificial light under proper regulations is, therefore, quite compatible with the most stringent sanatory

rules. In the usual process of gas manufacture there are generated, in addition to these illuminating hydro-carbons, ten other classes of gaseous constituents, impurities and diluents. With the exception of bisulphuret of carbon and some organic compounds containing sulphur, all the impurities are removed in the usual process of purification, which have now been brought to great perfection; but the presence of these sulphur compounds in coal gas is very objectionable, and constitutes the chief barrier to the universal employment of gas in dwelling-houses. The attention of the manufacturer ought, therefore, now to be earnestly directed to the discovery of means for preventing the formation of these compounds, as it will probably be found impossible to remove them from the gas when once they have been formed. In addition to traces of these sulphur compounds, purified coal gas contains only the following ingredients:—

Illuminating constituents.	Olefiant gas, ...	$C_2\ H_2$
	Propylene?	$C_3\ H_3$
	Butylene?	$C_4\ H_4$
	Other hydrocarbons, . . .	unknown.
Diluents.	Light carburetted hydrogen, .	$C\ H_2$
	Hydrogen, ...	H
	Carbonic oxide, ...	$C\ O$

The light emitted during the combustion of coal gas is due entirely to the first or illuminating class of constituents, which yield an amount of light proportional to the quantity of carbon contained in a given volume; thus, propylene and butylene yield respectively 50 and 100 per cent. more light than olefiant gas, because they contain respectively 50 and 100 per cent. more carbon in a given volume. It would not be desirable to employ a gas containing only luminiferous ingredients, even if it were possible to manufacture such a gas, because it is exceedingly difficult to consume these constituents without the production of smoke attendant on imperfect combustion. A diluting material is therefore necessary to give the flame a sufficient volume, so as to separate the particles of carbon farther asunder, and thus diminish the risk of their imperfect combustion. All the three diluents above mentioned perform this office equally well; but if we study their behavior during combustion, we shall find that in a sanatory point of view hydrogen is greatly to be preferred. The two objections most frequently urged against the use of gas in apartments are, first, the heat which it communicates to the atmosphere; and, second, the deterioration of the air by the production of carbonic acid. Now, in their action upon the atmosphere in which they are consumed, the above three diluents present striking differences in these two respects. One cubic foot of light carburetted hydrogen, at 60° F. and 30 in. barometrical pressure, consumes two cubic feet of oxygen during its combustion, and generates one cubic foot of carbonic acid, yielding a quantity of heat capable of heating 51 lbs.

14 oz. of water, from 32° to 112°, or causing a rise of temperature from 60° to 80.8° in a room containing 2,500 cubic feet of air. One cubic foot of carbonic oxide, at the same temperature and pressure, consumes during combustion half a cubic foot of oxygen, generates one cubic foot of carbonic acid, and affords heat capable of raising the temperature of 1 lb. 14 oz. of water from 60° to 66.6°. One cubic foot of hydrogen, at the same temperature and pressure, consumes half a cubit foot of oxygen, generates no carbonic acid, and yields heat capable of raising the temperature of 1 lb. 13 oz. of water from 32° to 212°, or that of 2,500 cubic feet of air from 60° to 66.4°. This comparison shows the great advantage which hydrogen possesses over the other diluents, especially over light carburetted hydrogen, which is evidently a very objectionable constituent, and shows that a normal gas for illuminating purposes should consist of illuminating hydrocarbons diluted with pure hydrogen. No method is known by which a gas of exactly this composition can be manufactured; but a very close approximation has been made to this normal gas, by the employment of a process known as White's hydrocarbon method of gas-making. In this process the very ingenious principle is adopted of generating the illuminating constituents in as concentrated a form as possible in one retort, and the diluents, consisting principally of hydrogen free from light carburetted hydrogen, in another. By this arrangement the diluents can be employed for a very remarkable and highly interesting purpose; they are conducted through the retort in which the illuminating constituents are being generated in such a manner as rapidly to sweep out those constituents before they have time to become decomposed by contact with the red-hot interior surfaces of the retort, a mode of destruction which occurs so largely in the usual process of gas-making. This mode of treatment produces a gain in the amount of illuminating power, derived from a given weight of coal, equal to from 50 to upwards of 100 per cent., whilst the increase in quantity of gas is frequently 300 per cent. The gas thus manufactured differs principally from coal gas made by the ordinary process, in having a large portion of the light carburetted hydrogen replaced by hydrogen; it is therefore, in a sanatory point of view, the best gas hitherto produced. This is seen in the following table, which exhibits the amount of carbonic acid and heat generated per hour by various sources of light, each equal to 20 sperm candles burning at the rate of 120 grains of sperm per hour.

	Carbonic Acid.	*Heat.*
Tallow,	10.1 cubic feet.	100
Wax, / Spermaceti,	8.3 "	82
Sperm oil, (Carcel's lamp,)	6.4 "	63
London gases, B, C, D, E,	5.0 "	47
Manchester gas,	4.0 "	32
London gas, A,	3.0 "	22
Boghead hydrocarbon gas,	2.6 "	19
Lesmahago hydrocarbon gas,	2.5 "	19

Notwithstanding the great economy and convenience attending the use of gas, and, in a sanatory point of view, the high position which, as an illuminating agent, coal gas of proper composition occupies, its use in dwelling houses is still extensively objected to. The objections are partly well founded and partly groundless. As is evident from the foregoing table, even the worst London gases produce, for a given amount of light, less carbonic acid and heat than either lamps or candles. But then, where gas is used, the consumer is never satisfied with a light equal in brilliancy only to that of lamps or candles; and consequently, when three or four times the amount of light is produced from a gas of bad composition, the heat and atmospheric deterioration greatly exceed the corresponding effects produced by the other means of illumination. By using a gas, however, of nearly the normal composition, such as the hydrocarbon gases above named, it is evident that three or four times the light may be employed, with the production of no greater heat or atmospheric deterioration than that caused by wax candles or the best constructed oil lamps. But there is nevertheless a real objection to the employment of gaslight in apartments, founded upon the production of sulphurous acid during its combustion: this sulphurous acid is derived from bisulphuret of carbon, and the organic sulphur compounds, which have already been referred to as incapable of removal from the gas by the present methods of purification. The formation of sulphurous acid can readily be proved, and even its amount estimated, by passing the products of combustion of a jet of gas through a small Liebig's condenser; the condensed product being heated to boiling with the addition of a few drops of nitric acid, and then treated with solution of chloride of barium, yields a white precipitate of sulphate of barytes if any sulphur compound be present in the gas. These impurities, which are encountered in almost all coal gas now used, are the principal if not the only source of the unpleasant symptoms experienced by many sensitive persons in rooms lighted with gas.

GAS AND GAS FIXTURES.

From a report recently made to the Directors of the Boston Gas Company, by Dr. A. A. Hayes, in answer to certain questions propounded, we make the following extracts. They will be found to imbody information of value to all gas companies and consumers, wherever located:—

1st. "On the value, purity and illuminating power of the Boston gas."

The value of purified gas depends on its illuminating power, determined by the light which a given volume will afford, as compared at the moment with that from some well-known source. By common consent, the standard adopted is a spermaceti candle consuming 120 grains per hour; and with such a standard the volume of five cubic feet of gas consumed in one hour from an argand burner is compared by photometric instruments. In the language of the gas engineers, five cubic feet of a gas affording the same light as thirteen sperm candles, burning $120 \times 13 = 1560$ grains of sperm per hour, is called *thirteen candle gas.*

By the term "purity" is understood entire freedom from carbonic acid gas, sulphuric acid gas, ammonia, vapors of sulphuretted compounds, and water.

A pure illuminating gas consists of a mixture containing carburetted hydrogen, carbonic oxide, hydrogen and nitrogen, olefiant gas, and vapors of benzole and naphtha.

The addition of the gases before named either diminishes the value of an illuminating gas by increasing the volume, or, as in the case of carbonic acid gas, it reduces the illuminating power in the act of combustion.

Referring to my records, I find the value of Boston gas averaged from daily observations for the year 1853 was 21 54.00 candles, and for eleven months of the present year 19 84.100 candles. The average, as shown for eleven months, was reduced in consequence of the supply of English coal during the first quarter being insufficient, from sea losses and failures on contracts.

Its purity has, throughout, been nearly perfect, so far as the usual impurities are referred to; an occasional occurrence of them only has been found, and then the cause could be traced easily. During a part of the warm season of 1854, the high temperature of the pipes *within the earth*, and that of the air and Cochituate water, has prevented the usual cooling of the gas, and consequent condensation of vapors of benzole, naphtha, and water, to the usual extent. Additional means having been secured, the gas has lately been cooled, and the mains and secondary pipes have been found to be clean.

2d. "Its value in comparison with other gases on record."

The experiments made almost daily have shown a mean value, during the present quarter, of 22 80.100 candles.

Nearly the whole of the gas supplied to the city of London, as appears from the records published monthly, has the value of 13 to 13 8.10 candles, while the cannel gas of Liverpool has been 22 candles. I have not obtained the numbers denoting the value of the New York gas; but from frequent intercourse with the gentlemen testing the gas there, I conclude that they have adopted the same standard as that chosen for Boston gas, viz., about 20 candles.

3d. "Are the burners in general use suited to the character of the gas?"

Recent experiments, carefully conducted, seem to indicate that the common burners heretofore used in this country and in Europe are not adapted to produce the most economical light from gas so rich as that supplied from your works. The advantage arising from the use of the French burner, with wide openings, has been fully proved in presence of distinguished, scientific, as well as skilful practical men, and the subject, in their hands, is likely to lead to improved applications.

4th. "Is there any process, chemical or practical, in use here or elsewhere, familiar to you, whereby Boston gas can be improved?"

I deem the present arrangements made at your works the most efficient which have been described, or are known to me. So far as they

have lately been brought into use, the results obtained have been of the most satisfactory character. They embrace the best parts of the improvements made abroad and at home, and will tend to obviate the evil every where felt, of a high natural temperature not under control in the condensation of gas.

5th. "Are there any suggestions which should be made to consumers upon the proper and economical use of gas?"

It has long been the custom in London to issue to consumers of gas, from time to time, little tracts on the subjects of gas distribution, measurement, and *care of fixtures;* this last is of eminent importance. A compilation of this kind has been examined by myself, and it will probably soon be published here. As the duty of the manufacturer of gas to the consumer ceases when he has delivered within the meter a pure gas of high illuminating quality, under a regulated pressure, attention is required of the consumer, if he would enjoy the comfort and advantage of a good light. Illuminating gas is not a permanent body, and it cannot, like air, enter and leave small tubes without soiling them, especially if it reposes in them when air has access. It has a constant tendency to produce fluid, and even solid bitumens, by oxidation from admixture with air; and in the open space between the key and the stop-cock and the burner,—except while the gas is burning,—*air is always present.*

Hence all fixtures require *periodical cleaning,* as every species of apparatus or machinery does, and burners of every form should be cleansed by using the instruments gratuitously supplied by your company.

The most common causes of annoyance to consumers are, the allowing of gas to remain in the distribution pipes during the summer, or when the burners are not in use, and the displacements or imperfect laying of the pipes within the buildings, allowing them to contain fluids. Not only are the pipes liable to become coated by changes in the included gas, but, as it acts on and solidifies all lubricating substances hitherto used, the keys of stop-cocks become fixed and small openings stopped. Gas of high value contains six per cent. of its volume in vapor, which can become fluid in the pipes when they are exposed to the temperature of freezing water. Hence depressions in the pipes soon collect fluids; and unless the pipes decline *towards* instead of *from* the metre, the flow of the gas to the burner is irregular.

As the facts forming part of these replies might be supposed to rest on individual authority, I will add, that the experiments have often been made before the most distinguished scientific men of our country, and in more than one instance submitted to the consideration and criticism of those from abroad, with the expression of their entire approval.

It is hardly necessary that I should allude to the quality of the coals used in producing gas of the high value given by the experiments, as *impure coal does not produce such gas.*

ON THE INFLUENCE OF THE AIR ON FERMENTATION AND PUTREFACTION.

Fermentation is one of the chemical phenomena whose causes have been the most actively discussed since chemistry became an experimental science. When Gay-Lussac showed that a mixture of sugar and water, with a ferment, will remain good *in vacuo* for an indefinite length of time, and that the reaction commenced on the introduction of a single bubble of oxygen, he attributed the fermentation to electricity. This view was supported by the experiment of M. Collin, according to which, in liquids that do not ferment, the phenomenon of fermentation is instantly produced under the influence of the voltaic current.

According to Cagnard Latour's theory, yeast is formed of a number of minute vegetable growths, living at the expense of the saccharine matter; the transformation of this matter into alcohol and carbonic acid, that is, fermentation properly so called, is a physiological act, likened to germination, likewise accompanied by the decomposition of the sugar, disengagement of the carbonic acid, and an elevation of temperature. To these theories, exclusively applicable to alcoholic fermentation, and which, with difficulty, explain why a small quantity of yeast is sufficient to decompose a great quantity of sugar, Liebig opposes a purely mechanical theory, which he extends to catalytic effects, as well as to the phenomena of putrefaction and eremecausis, and which he bases on the principle laid down by Laplace and Berthollet—*that a molecule, being set in motion by any force whatever, may communicate this movement to another molecule in contact with it;* this principle, which manifests itself whenever the resistance (cohesion or affinity) is insufficient to be an equilibrium to the movement, moreover accords with the proposition of M. Millon, that, in certain cases, the infinitely large mass submits to the law of the infinitely small quantity; a proposition applied by him to catalytic actions, and justified even by purely physical phenomena.

Of all the facts adduced against this mechanical theory, doubtless none have been so valuable as those observed by Dr. Ure, Schwann, and Helmholtz. Accordingly the Gay-Lussac's experiment only succeeds when the oxygen destined to provoke the fermentation has previously passed through a porcelain tube, heated to redness; blood, muscular flesh, a mixture of ferment with sugar and water, may be preserved intact in atmospheric air, if kept at a heat of at least 212° Fahrenheit. This led Schwann to think that the spontaneous decomposition called fermentation, or putrefaction, was nothing but the results of the vital manifestations of some cryptogamic or microscopical animalcules, produced by the spores and germs contained in the atmosphere, and becoming developed when they found themselves in a favorable medium. The miasmata and contagions which Liebig considers as connected with the cause to which he attributes fermentation, would, therefore, only proceed themselves from these micro-

scopical germs, introduced into the blood by the respiration, and becoming propagated there at the expense of this nourishing liquid. An illustration quoted by M. Becquerel, respecting the effects of the Roman Pontine marshes, sustains this view. "A forest interposed to the passage of a current of moist air, charged with pestilential miasmata, sometimes preserves all behind it from its effects, whereas the uncovered portion is exposed to diseases. The trees, in such cases, appear to filter the air, and to purify it by removing the miasmata."

Applying Schwann's ideas to these facts, MM. Schroeder and Dasch proposed to eliminate the germs of the infusoria by a species of filtration, copied from that which Nature has organized upon the large scale; and knowing that cotton wadding condenses pestilential miasmata on its surface, and thus renders them liable to be transported to a distance, they have availed themselves of this substance to filter the atmospheric air which might enter into their experiments.

The general result of these investigations is, that filtered air behaves like calcined air; it is incapable of producing fermentation or putrefaction. The filter used consists of a tube filled lightly with cotton, previously heated. The apparatus employed consisted of a glass balloon, capable of being closed hermetically, and filled through cotton by means of a gasometer and aspirator. The result of numerous experiments, made under different conditions, showed *that meat recently boiled, as well as fresh broth, remained intact for several weeks in an atmosphere which had previously been filtered through cotton.* Meat exposed under the same circumstances, in ordinary air, became putrid in a few days.

Filtered air was also found to prevent mouldiness in milk.

Hitherto, the existence in the air of these organisms has been contested; the part first attributed to them by Schroeder and Dasch may be filled with some substance with powerful affinities, such as ozone. The innocuity of calcined or filtered air may be as well explained by this hypothesis as by that of Schwann; he, at any rate, proved that air always contains ozone; we likewise know that this allotropic oxygen possesses an affinity of a hundred times the strength of common oxygen; and it will be easily understood that, in the presence of the vegetable fibre of the cotton, this affinity would be able to satisfy itself amply. The filtered air may therefore be free from ozone, and it is not probable that it would resume this body in repassing through the filter; whereas it would probably resume the organic germs, which the cotton could only fix physically, and which would be accumulated at the entrance of the tube, as it results from observations made with fermentable substances contained in balloons simply closed with a pad of cotton.—*Ann. der Chemie und Pharmacie.*

EXPERIMENTS RESPECTING THE EXPLOSIVE CHARACTER OF CERTAIN COMPOUNDS.

In the month of September, 1854, during an extensive conflagration at Newcastle, England, a warehouse, containing a large quantity of nitrate of soda, sulphur, and other materials, took fire. Water being thrown upon the burning mass, a tremendous explosion occurred, killing and wounding many persons, and destroying all the adjacent structures. Some doubt prevailing respecting the cause of the explosion, a number of interesting experiments were made before the coroner's jury, under the direction of Mr. Pattinson, and Captain Du Cane, of the Royal Engineers, who was detailed by government for the investigation. Under their direction, an iron pot about 12 inches in diameter was sunk into the earth, in such way that the rim was on a level with the surface. Into this pot were put about 9 lbs. of nitrate of soda and 6 lbs. of sulphur, which were ignited; and when burning at their greatest fury, and throwing up a brilliant flame, a quantity of water, little more than a pint, was projected into the vessel by means of a long iron spout, so placed that the water fell into the fire from an angle of about 30 degrees. As soon as the water touched the incandescent mass a loud report was heard; and almost before it could be remarked, another and much louder explosion followed. The experiment was repeated, and this time with more instantaneous effect, and the explosion occurred with greater violence, as if the noise of the two former explosions were on this occasion thrown into one. Most of the jurymen, who, like every body else, kept carefully under shelter while the experiments were going on, now expressed themselves satisfied; but Captain Du Cane and the coroner expressed a wish to see the effect of an explosion when a weight was put over the top of the pot. Mr. Pattinson at first objected to this, from the danger that might result both to the persons of the spectators and of the surrounding buildings; but on its being suggested that the experiment might be tried in an open field, which would afford room for persons to remain at a safe distance and yet witness the explosion, he consented. The whole party then moved off to where a drift-way or mine had been carried for some distance into the face of a steepish bank. The pot was sunk at the entrance to the mine, upon the level ground. The spout from which the water was to be poured was placed at a rather lower elevation than before, up the covered way, where one of Mr. Pattinson's coadjutors was hardy enough to station himself, while all the rest retreated to a safe distance. On this occasion there was the usual quantity of nitre and sulphur placed in the pot, and about five or six cwt. of clay and bars of iron were placed over it, but so as to allow a free passage for the water. When all had retreated, the water was poured, but the result was a disappointment; whether the water was not poured with sufficient steadiness, or whether, as is most likely, the heat of the nitre—which only burned a few minutes—had been allowed to go down before the experi-

ment was tried, the anxiously-looked-for experiment proved a failure. Instead of a loud explosion, and the lumps of clay blown in fragments into the air, a noise that could hardly be called an explosion was heard, and the weights were found to be undisturbed. The experiment was again tried, and again with results little better. The spout was supposed to be too nearly on a level; it was brought out of the drift-way and led up the hill, so as to be nearly perpendicular; and when the water—this time also increased in quantity—was poured in this manner, a greater explosion was produced, and considerable disturbance of the superabundant materials was manifest; but still the effect was not equal to what had been anticipated. It was then determined to remove the clay altogether, and to try the effect of placing one iron pot inverted over the top of the other. By this time the repeated failures had emboldened the spectators, and several of them were now induced to join Captain Du Cane, who from the beginning had placed himself in an inconvenient proximity to the scene of the experiment, which nobody else had, up to this time, cared to imitate. The materials were again ignited, the word was given, the water was poured, and a miserably disappointing "puff" was again the result. The spectators looked blankly at each other, and then a step or two was made to examine the cause of the failure; when, crash! a tremendous explosion was heard, and the iron pot which rested on the top of the burning mass was sent soaring high up into the air, a height of from 50 to 70 feet. A few moments longer, and it would have encountered in its first progress the heads of some half dozen curious gazers in the drift-way.

ON THE MEANS TO BE EMPLOYED FOR DETECTING AND RENDERING PERCEPTIBLE FRAUDULENT ALTERATIONS IN PUBLIC AND PRIVATE DOCUMENTS.—*Chevallier and Lassiagne.*

The numerous experiments which have been already tried at various times, have made known the processes which may frequently be put in practice for causing the reappearance of traces of writing effaced by chemical reactions, and for throwing light on the work of the guilty. But there are cases in which all the means proposed for this purpose fail, and then the criminal may escape justice from the want of conclusive material proofs. If, as has already been proved, it is not always possible to cause the reappearance of the effaced writing, for which other written words have with a fraudulent intent been substituted, at least, as our experiments demonstrate, we may recognize, by some effects which are manifest on the surface of the altered paper, the places where the criminal act has been performed, circumscribe them by a simple chemical reaction visible to the least practised eye, and even measure their extent. In a word, the invisible alterations produced on a deed are susceptible, owing to the partial modifications which the surface of the paper has undergone, of being differently affected by certain chemical actions, and of being rendered

visible. The following experiments, made in a judicial investigation, furnish us with the following facts :—

1st. The surface of paper sized in the ordinary way, or letter paper, no longer presents with certain reactions the same uniformity where it has been either accidently moistened in several places by various liquids, or left in contact for a certain time with agents capable of removing or destroying the characters which have been traced on it with ink.

2d. The application of a thin layer of gum, of starch, or farina, of gelatine, or fish-glue, with a view of sizing certain parts of the paper, or of causing certain bodies to adhere to it momentarily, is detected by an action similar to that which shows paper to have lately been blotted by the contact of liquids.

3d. The heterogeneousness of the pulp of the papers, and the kind of size with which they are impregnated, lead to differences in the results which are observed with the same chemical reagents. We shall now examine each of these propositions, and describe the means which we have employed in endeavoring to solve questions of so high a degree of interest.

1st. The homogeneousness of sized paper not partially altered by the contact of liquids (water, alcohol, salt-water, vinegar, saliva, tears, urine, acid-salts, and alkaline salts) is demonstrated by the uniform coloration which this surface takes on being exposed, if not wholly, at least in various parts, to the action of the vapor of iodine disengaged at the ordinary temperature from a flask containing a portion of that metalloid. When the surface of paper not stained by any of the above-mentioned liquids is exposed to the action of this vapor for three or four minutes in a room the temperature of which is about 60° F., a uniform yellowish, or light-brownish yellow, coloration is noticed on the whole extent exposed to the vapor of iodine; in the contrary case, the surface which has been moistened, and afterwards dried in the open air, is perfectly distinguished by a different and well-circumscribed tint. On the papers into whose paste starch and rosin have been introduced, the stains present such delicate reactions that we may sometimes distinguish by their color the portion of paper which has been moistened with alcohol from that what has been moistened with water. The stain produced by alcohol takes a bistre-yellow tint; that formed by water is colored of a more or less deep violet blue, the desiccation having been effected at the ordinary temperature. For the stains occasioned on these same papers by other aqueous liquids, the tint, apart from its intensity, resembles that of the stains of pure water. The feeble or dilute acids act like water on the surface of the same paper containing starch in its paste; but the concentrated mineral acids, by altering more or less the substances which enter into the composition of the latter, give test to the stains which present differences. We are always able to recognize by the action of the vapor of iodine the parts of the paper which have been put in contact with chemical agents, the energy of which has been arrested by washing in cold water. We were able, on several

ancient deeds, written on stamped paper, and a few words of which had been removed by us with chemical agents, to recognize the places where their action was exerted, to see and to measure the extent which they occupied on the surface of the paper.

The testing of a paper with the vapor of iodine will present this double advantage over the methods hitherto practised for detecting falsifications in writings, that it points out at once the place in the paper in which any alteration may be suspected, and that, on the other hand, it enables us to act afterwards with the reagents proper for causing the reappearance of traces of ink, when that is possible. If the means which we now propose cannot always make the former writing appear, they demonstrate the places where the alterations must have been made, when, however, the want of uniformity presented by the surface of the paper is not explained by any circumstance. This proof becomes, therefore, a weapon which the guilty person cannot avoid. But might not the presence of a stain, or several stains, developed by the vapor of iodine, in different parts of a public or private deed, give rise to a suspicion, where these stains have, perhaps, been occasioned by the spilling of some liquid on the surface of the paper? and would it not be rash and unjust to raise an accusation from such a fact? There would indeed be great temerity in drawing such a conclusion from a fortuitous circumstance; but the inference which may be drawn from the place occupied by these stains on the surface of the paper, from the more or less significant words found in those places, would not permit an accusation to be so lightly brought, where simple reasoning would be sufficient to destroy its basis. Besides, the subsequent reactions which would be made would certainly never revive words formerly written and effaced; whilst the latter effects may be often produced, more or less visibly, on those parts of the paper on which falsification has been practised, figures or words being substituted for other figures or words.

2d. The applications made to the surface of a sheet of paper, with a view of covering it again at certain parts with a fine layer of gum, gelatine, starch, or flour paste, or in other places to cause other sheets of paper to adhere, may be recognized not only by the reflection of light falling upon the paper inclined as a certain degree of obliquity, and by the transmission of light through the paper, but also by the varying action which the vapor of iodine exerts on the surface which is not homogeneous. Papers containing starch and resin are more powerfully acted upon by this vapor than papers of a less complex composition. Both in the parts covered with starch, or flour paste, are colored in a few minutes of a violet blue; but with starched papers alone a more intense coloration is manifest on the places covered again with a thin layer of gum arabic, size, or gelatine. By looking, then, at the surface of the paper, held somewhat obliquely to incidental light, we distinguish clearly, by their different aspect, the parts on which these various substances have been applied. The vapor of iodine, in condensing at the ordinary temperature on the surface of the papers to

which any kind of size has been applied in various places, produces differences which are most commonly well recognized by the greater or less transparence of the paste of the paper.

3d. The heterogenousness of the pulp of the various papers of commerce, and the nature of the size with which they are penetrated, cause differences, either in the coloration which the surface of these papers takes when exposed to the vapor of iodine, or in the tint which is manifested in the portions of the size deposited in certain portions of that surface; thus, papers with starched pulp generally turn brown, or blue, according to the amount of water that remains in their interstices; other papers turn yellow only under the influence of the vapor of iodine, and the parts which have received superficially a layer of another agglutinative body resist this action for a certain time, and are distinguished from the parts of the paper which are not covered with it.—*Jour. de Chimie Médical.*

ON THE ACIDITY, SWEETNESS AND STRENGTH, OF WINE, BEER AND SPIRITS.

The following communication on the above subject has been presented to the Royal Society, England, by H. Bence Jones, F. R. S.:—

The acidity of the different liquids was determined by means of a standard solution of caustic soda. The quantity of liquid neutralized was always equal in bulk to 1000 grs. of water at 60° F.

The acidity in different

Sherries	varied	from	1.95	grs. to	2.85	grs.	of caustic	soda.
Madeira	"	"	2.70	"	3.60	"	"	"
Port	"	"	2.10	"	2.55	"	"	"
Claret	"	"	2.55	"	3.45	"	"	"
Burgundy	"	"	2.55	"	4.05	"	"	"
Champagne	"	"	2.40	"	3.15	"	"	"
Rhine wine	"	"	3.15	"	3.60	"	"	"
Moselle	"	"	2.85	"	4.50	"	"	"
Brandy	"	"	0.15	"	0.60	"	"	"
Rum	"	"	0.15	"	0.30	"	"	"
Whiskey	"	"	0.07	"	–	"	"	"
Bitter ale	"	"	0.90	"	1.65	"	"	"
Porter	"	"	1.80	"	2.10	"	"	"
Cider	"	"	1.85	"	3.90	"	"	"

Hence the order in which these wines may be arranged, beginning with the least acid, is, Sherry, Port, Champagne, Claret, Madeira, Burgundy, Rhine, Moselle, &c.

The sugar was determined by means of Soleil's saccharometer, which at least gives the lowest limit to the amount of sugar.

The sweetness in different

Sherries	varied from		4 grs.	to	18 grs.	in the ounce.		
Madeira	"	"	6	"	20	"	"	"
Champagne	"	"	6	"	28	"	"	"
Port	"	"	16	"	34	"	"	"
Malmsey	"	"	56	"	66	"	"	"
Tokay	"	"	74	"	–		"	"
Paxarette	"	"	94	"	–		"	"

Claret, Burgundy, Rhine, and Moselle contained no sugar. Hence the order in which these wines may be arranged, beginning with the driest, is, Claret, Burgundy, Rhine and Moselle, Sherry, Madeira, Champagne, Port, Malmsey, Tokay, Paxarette.

In a dietetic view, assuming that the sugar becomes acid, then the mean results as to the acidity of the different fluids examined, beginning with the least acid, is, Whiskey, Rum, Brandy, Claret, Burgundy, Rhine wine, Moselle, Sherry, Madeira, Champagne, Cider, Port, Porter, Malmsey and Madeira, Ale, Tokay.

The alcoholic strength of different samples of

Port	varied from		20.7 per cent.	to	23.2	per cent.
Sherry	"	"	15.4	"	24.7	"
Madeira	"	"	19.0	"	19.7	"
Claret	"	"	9.1	"	11.1	"
Burgundy	"	"	10.1	"	13.2	"
Rhine wine	"	"	9.5	"	13.0	"
Moselle	"	"	8.7	"	9.4	"
Champagne	"	"	14.1	"	14.8	"
Brandy	"	"	50.4	"	53.8	"
Rum	"	"	72.0	"	77.1	"
Whiskey	"	"	59.3	"	–	"
Cider	"	"	5.4	"	7.5	"
Bitter ale	"	"	6.6	"	12.3	"
Porter	"	"	6.5	"	7.0	"

The Burgundy and Claret have less alcohol than was found by Brande forty years ago in the wines he examined. The Sherry is now stronger, the Port is not so strong, the Rhine wine is of the same strength, and the Brandy is as strong as formerly; the Rum is nearly half as strong again; the Porter is stronger.

In those wines in which the amount of alcohol was the same, the specific gravity was found to vary with the amount of sugar found by the saccharometer.

ON THE CHEMICO-PHYSIOLOGICAL EFFECTS OF COFFEE.

[A report of some elaborate investigations of the action of coffee upon the human organism, with a statement of their results, by Julius Lehmann, has been translated from the German, and published in the Philadelphia Medical Examiner. The latter part we copy in full.]

If we now consider the results of all the investigations and experiments, we arrive at the conclusions :—

1st. That the use of the decoction of coffee produces two important actions in the system, which are difficult to harmonize; viz., stimulating the vascular and nervous systems to greater activity, and at the same considerably retarding the metamorphosis.

2d. That the stimulating effect above mentioned, so valuable to us from its reviving the wearied spirit, and disposing to thought and promoting a feeling of comfort and cheerfulness, is due to the opposing modifications of the action of empyreumatic oil and caffein.

3d. That the retarding of the metamorphosis is mainly due to the oil—the caffein showing this *only* when it exists in large quantities.

4th. That increased activity of the heart, trembling, dizziness, delirium, intoxication, &c., are the effects of caffein.

5th. That the increased action of the perspiratory organs, of the kidneys, of the peristalic action, and of the brain, are the effects of the empyreumatic oil.

If the decoction be too strong, that is to say, if it is prepared in such a way as to contain too great a quantity of both substances for the system, then occur the effects peculiar to both, trembling, activity of the heart, congestion, &c. If we consider these two chief actions of coffee, which are peculiar to some other substances, such as tea, cocoa, spirituous liquors, &c., though in a modified degree, we observe that they are at variance with the general law, that the greater the expenditure of mental and bodily activity, the greater the waste—or rather the metamorphosis of the system. Whether this excitement of the vascular nervous system occasions more rapidly the destruction of the processes of life, or how these two opposing effects are to be explained, remains for the future to discover.

Concluding Observations.—One who is familiar with the general laws above mentioned will find it difficult to comprehend the strength, busy life and good health of the poorer classes, when he considers these in connection with the very small amount of actual nourishment that they are able to obtain. And, in fact, the existence of such persons would have been inconceivable, if no means of supporting their health and strength had been provided, besides that small amount of actual nourishment. Limited to that alone, there would have been a great disproportion between the amount received and that thrown off; the tissues must have suffered a continual waste, even to the dissolution of life.

But instinct has taught them to make use of a substance, which is capable of making a too scanty nourishment sufficient to the system, and by by preventing in this way the otherwise unavoidable disturbances of the balances of life.

It is particularly coffee, tea, cocoa, empyreumatic oils and alcoholic liquors, that possess this peculiar influence on the system, and most of these agree in producing that excitement of the nervous system of so great importance in social life.

If we now reflect upon the distribution of these substances, we find that one of them is used by the people as a common article of food, while the others are enjoyed by the higher classes as articles of luxury. In those countries where one or other of these substances is cultivated, its culture is considered a matter of chief importance by the people: thus, in Arabia, coffee; in China, tea; in the wine-producing countries, wine. On the contrary, where this is not the case, the choice has fallen almost exclusively on coffee or tea. The reason why the preference is given to these, particularly in Europe, is owing principally to the fact that they exert a far less injurious influence upon the system than alcoholic drinks, and also on account of their valuable action upon the nervous system from the united effects of coffee and empyreumatic oil. For, while, by stimulating the reason and imagination, these prepare man for intellectual and bodily exertion, spirituous liquors, exciting only his imagination, which degenerates by slight excess into confusion of thought, cause, by irritating the nervous system, general debility. These latter, therefore, can be used with much less safety than coffee or tea.

An attentive consideration of the quality and quantity of the composition of coffee and tea, the various modes of preparing them, as well as their action upon the system in connection with the kind of food used, will probably account for the peculiar preferences of nations for the one over the other. If the composition of tea leaves be compared with roasted coffee, we find that they both possess those substances that are of such great importance—thein, ethereal oil, and protein substance. The only difference between them is, that the coffee contains an aromatic substance, and the tea a greater amount of thein, but especially of ethereal oil. Three most important effects are produced by these constituents:—1. The retarding of metamorphosis produced by the thein, but more particularly by the aromatic substance in coffee. 2. The lengthened activity of the brain, produced by the special action of thein and ethereal oil. 3. Serving as an actual means of nourishment, by the amount of protein substance contained in them. Coffee influences more directly the metamorphosis, and tea the nervous system. In order to obtain completely these effects of the two drinks, they must be partaken of in substance. This occurs, however, only among few nations, and is probably dependent upon the kind of food used and their mode of life. The Orientals and Arabs regard coffee as a necessary article of food, and from their custom of drinking it with the dregs, thus making the large amount of protein substance and

inorganic constituents serve as nourishment, have unconsciously rendered their very frugal diet less sensible to them. If the plastic ingredients are not of themselves sufficient, yet here come to their assistance the indirect nourishing property of caffein and the aromatic substance—equalizing their necessities, and at the same time exciting their nervous system.

The Central Asiatic inhabitants of the Steppes, the Buratians, the Mongolians, &c., make use of tea as a common article of food. They prepare it, first, by rubbing the leaves together, then boiling it in water, adding a little salt to it; after they have poured off the decoction from the dregs, they add to it butter and milk, and meal if they have any, which they roast before adding to the decoction. A person takes per day from twenty to forty cups. But even without meal, and only with a little milk, this tea often serves, for weeks long, as the only means of nourishment. We see here again a people instinctively directed, as it were, in the peculiar mode of preparing tea; unconsciously adding those substances which are of such great importance, viz., the protein, that becomes soluble by boiling in salt water, and also a great portion of the inorganic constituents. It is probably here the large amount of thein that influences the metamorphosis. Of course they lose entirely the valuable property of the united action of ethereal oil and thein, since by boiling the former is dissipated. This could better be spared, though, than the other action of tea, which serves as a direct nourishment, which is of greater importance.

The mode of preparing these drinks among Europeans is very different—not placing much value upon the nutritive substances contained in them, but merely upon those which are capable indirectly of nourishing, and those which induce greater activity of the nervous system and the brain. The mode of preparing coffee among the Germans enables them to obtain, besides the empyreumatic oil, as much caffein as they can possibly obtain from it; while in the preparation of tea, less attention is paid to the amount of thein than to the ethereal oil—the whole amount of which passes over to the decoction. Hence, with them, tea acts only as a stimulus to their brain and nervous system, whilst coffee retards the metamorphosis, and also, though not in so great a degree as tea, stimulates the nerves. The English, who produce so much meat in their own country, and can generally obtain so much of it that it is even possible for the poorer classes to partake of it daily, besides the protein substances, have less need to prepare their coffee in such a manner as to obtain from it indirect nourishment. Since, however, they feel the want of spirits and excitement, their choice has fallen upon tea, which promotes these better than coffee.

We find among the poorer classes of Germany, where meat is so rare, and considered so great a luxury, that they are obliged to substitute for it such food as potatoes, &c., which consist of substances which indeed satisfy their hunger, but yet are not fitted to prepare them for very great exertions. The feeling of mental and physical lethargy experienced by them, and produced by this spare diet, becomes much more evident if they

suffer for the want of coffee. The rapid diffusion and yearly increase of the consumption of coffee is an evidence of the great importance it has attained in social life.

Whilst, at the beginning of the last century, it was considered a luxury by the higher classes, it has now become a necessary article to all classes wherever food is scarce and dear. Of its total production, which amounts annually to 600,000,000 of pounds, two-thirds are consumed by the Europeans, whose exertions appear so disproportioned to the actual means of nourishment. In the Zollverein States of Germany, the consumption of it amounted, in 1851, to 100,000,000 pounds, or one-sixth of the total production. Upon each reduction of duty, millions of pounds more were consumed by the people, the consumption of coffee and potatoes, from the period of their general introduction, having gone hand in hand. We see the poor instinctively valuing coffee more, the more they are limited to potatoes as their chief food.

ARTIFICIAL SILICIFICATION OF LIMESTONES.

It is some years since M. Kuhlmann of Lille proposed to preserve pieces of sculpture, &c., by impregnating them with a solution of silicate of potash. $SiO^3\ KO+CO^2\ CaO=SiO^3\ CaO+CO^2\ KO$. This process has been used on a grand scale in certain parts of the Cathedral of Notre Dame. The architect of the cathedral reports as follows: 1. That the infiltration of silica made "sur les terrasses et contre-fort du chœur," in October, 1852, has preserved the stone from the green moss that covers stones in moist places: 2. That the gutters and flagging of limestone subjected to this process present surfaces perfectly dry, covered with a silicious crust: 3. That upon the stones so prepared, dust and spider webs are less common than upon the stone in the ordinary state. The report also states that tender stones have been rendered hard; they have lost part of their porosity, and, after being washed, they dry more rapidly than stones not silicified. The process has succeeded completely on all calcareous blocks, whether isolated or forming part of the structure, new and old.

It is not yet known how this process will act on mortars; but if successful, the silicification of an entire monument may be accomplished, and its restoration when old. The whole exterior might be thus covered with a thick bed of artificial silicate of lime, and a whole edifice be protected by this means from all atmospheric causes of destruction.—*Silliman's Journal.*

THE STEREOCHROME OF FUCHS.

The formation of an insoluble cement by means of the soluble silicates, (water-glass,) whenever the carbonic acid of the atmosphere acts on this substance, or whenever it is brought in contact with a lime-salt, has been applied by Fuchs to a most important purpose in the stereochrome. This is essentially a process of fresco, invested with a capability of receiving

and perpetuating works of the highest artistic character, and which may be executed on a vast scale. Fuchs' method is as follows: Clean and washed quartz-sand is mixed with the smallest quantity of lime which will enable the plasterer to place it on the wall. The surface is then taken off with an iron-scraper, in order to remove the layer formed in contact with the atmosphere, the wall being still moist during the operation. The wall is then allowed to dry; after drying, it is just in the state in which it could be rubbed off with the finger. The wall has now to be fixed, i. e., moistened with water-glass. (An important point is, not to use too much water-glass in moistening the wall.) This operation is usually performed with a brush. The wall must be left in such a condition as to be capable of receiving colors when afterwards painted on. If, as frequently happens, the wall has been too strongly fixed, the surface has to be removed with pumice, and to be fixed again. Being fixed in this manner, the wall is suffered to dry. Before the painter begins, he moistens the part on which he purposes to work with distilled water, squirted on by a syringe. He then paints: if he wishes to repaint any part, he moistens again. As soon as the picture is finished, it is syringed over with water-glass. After the wall is dry, the syringing is continued as long as a wet sponge can remove any of the color. An efflorescence of carbonate of soda sometimes appears on the picture soon after its completion. This may either be removed by syringing with water, or may be left to the action of the atmosphere. Not to dwell on the obvious advantages possessed by the stereochrome over the real fresco, (such as its admitting of being retouched and its dispensing with joinings,) it appears that damp and atmospheric influences, notoriously destructive of real fresco, do not injure pictures executed by this process. The following crucial experiment was made on one of these pictures. It was suspended for twelve months in the open air, under the principal chimney of the New Museum at Berlin; "during that time it was exposed to sunshine, mist, snow, and rain," and nevertheless "retained its full brilliancy of color."

IODINE AS AN ANTIDOTE FOR POISONS.

M. Bernard established some time ago that the solutions of iodine act as antidotes against the bite of venomous serpents, and especially of the crotales. He has recently communicated another note (framed conjointly with M. Greene) to the Academy of Sciences, to state that the same solutions of iodine have a similar influence on the South American poisons called curare. Their experiments support the opinion long currently believed, that the poison of serpents is an ingredient of these poisons, which have two effects analogous to those of the bites of the most dangerous serpents. The curare is so very active that a dose of two or three centigrammes proves fatal to an animal of the size of a pigeon or a guinea pig; but when this poison was mixed with a solution of iodine or iodurated pot assium, it may be injected under the skin without danger. The poison may even be

injected first, and the iodine afterwards, without the former affecting the animal: in this case, it suffices to suspend the absorption of the toxical substance by the application of a cupping glass, which gives to the chemical reactive the time to meet the curare and to operate its disorganization. The same remarks apply to the ticunas, another sort of poison which comes from the borders of the Amazon. After this note had been read, M. Boussingault said he did not think it sufficiently established that the curare contains the poison of serpents; he said that, at the least, he could affirm that the curare he brought from one of the affluent streams of the Amazon contained none: the Indians obtained it by pounding in cold water the bark of a vejuca, which is very common in the forests traversed by the great rivers of Equatorial America. It was with this same curare, given to M. Pelouze in 1833, that M. Bernard made these interesting experiments.

ON THE SO CALLED AMORPHOUS PHOSPHORUS.

M. Puttfarcken has examined some amorphous phosphorus obtained from England. He received it in the form of a brownish red, shining, coherent powder, the peculiar odor of which powerfully affected the eyes.

By long washing with pure water, the phosphorus lost thirteen per cent. in weight. The wash-water contained phosphorus and phosphoric acids, and a small quantity of phosphate of lime. The powder, when exhausted by water, was put, when dry and neutral, into well-stopped vessels; it had, however, again become acid in a very short time.

Fifteen grms. of the so called amorphous phosphorus were oxidized with nitric acid; this was readily effected without the assistance of heat, merely by the gradual addition of the phosphorus to the nitric acid. 135 grms. of fluid phosphoric acid, of specific gravity 1.13, were obtained. Sulphuretted hydrogen, however, threw down so much sulphuret of arsenic from this phosphoric acid that the quantity of metal in the phosphorus must have been equal to one-half per cent.

For the sake of comparison, fifteen grms. of common phosphorus were converted into phosphoric acid of the same specific gravity. The quantity of acid was 160 grms.

Exposure to a temperature of 392°–437° F. for three days left the amorphous phosphorus unchanged, so that even the microscope could detect no globules of ordinary phosphorus. When heated in a glass tube drawn out to a capillary point, it became black, with evolution of a strong odor of phosphuretted hydrogen, which probably arose from the decomposition of the moist phosphoric acid. It did not fuse during the operation, and on cooling re-acquired its original color. After the tip of the glass tube had been sealed up, the tube was inserted into another a little wider, and then strongly heated for a considerable time with the blow-pipe. No sublimate was produced, nor had the substance undergone any change by its exposure to a red heat. Boiled with solution of caustic potash, the sub-

stance evolved no phosphuretted hydrogen. Oil of turpentine dissolved much less of it than of ordinary phosphorus.

From this the author concludes that the so called amorphous phosphorus does not deserve this name. It is rather a low oxide of phosphorus.—*Archiv der Pharm.*

ON THE PRODUCTION OF BORACIC ACID AND AMMONIA BY VOLCANIC ACTION.

Mr. R. Warrington stated to the British Association that in 1841 a friend of his had visited the island called Volcano, situated about twelve miles north of Sicily. The height of the mountain Volcano is 2,000 feet; and the depth of the crater 700 feet. The sides of this depression are covered with a white snow-like substance about one inch in thickness, beneath which is a fused lava, similar in appearance to the slag of a glasshouse. The boracic acid rises in vapor and condenses on the surface of the ground or in crevices at the bottom of the crater, from which about 2,000 tons are annually removed. It occurs connected with sal ammoniac, and the author considers that it exists originally beneath the surface as a nitride of boron. When steam is passed over this compound at a moderate red heat, it is completely converted into boracic acid and ammonia, which are for the most part volatilized with the aqueous vapors. This theory of the formation of boracic acid was considered by the author substantiated by the analysis of the slag beneath and the snow-like mass above. The former contained nitride of boron, and the latter boracic acid and ammoniacal salts.

VESSELS FOR THE PRESERVATION OF FLUOHYDRIC ACID.

Städeler has found that gutta percha and vulcanized India rubber resist the action of fluohydric acid almost completely. A solution of the acid, which was so concentrated as to fume in the air, was found, after having been for some time preserved in a bottle made of gutta percha, perfectly colorless and clear. The gutta percha had undergone no change, but was somewhat brighter colored on the inside.—*Ann. der Chemie und Pharmacie*, lxxxvii. 137. [It would doubtless be possible to cover the inside surface of a glass bottle with gutta percha by pouring in a solution of the gum resin in chloroform.]

OXIDE OF GOLD.

Figuier, who tested the several methods of preparing this oxide, now so extensively used in electro-gilding, has determined the best to be as follows: Dissolve 1 pt. gold in 4 pts. aqua regia, evaporate to dryness, redissolve in water, add a little aqua regia to take up the traces of metallic gold and of protochloride remaining undissolved. Evaporate again, redissolve in water, and mix with pure potassa perfectly free from chloride,

until it gives an alkaline reaction with turmeric paper. Turbidity immediately ensues, when it is mixed with chloride of barium; aurate of baryta precipitates as a yellow powder. When the precipitate begins to assume a whitish appearance, the addition of chloride of barium must be discontinued, as all the gold oxide has gone down, and the alkali commenced to act upon the baryta of the chloride. The aurate of baryta is then to be washed until the waste-waters cease to be precipitated by sulphuric acid. The aurate is then heated to boiling, with dilute nitric acid, in order to eliminate the oxide of gold. By washing until the water no longer reddens litmus paper the oxide becomes pure, and must be dried between the folds of bibulous paper by exposure to air.—*Jour. de Pharm.*

ON THE RECOVERY OF GOLD AND SILVER FROM THE FLUIDS EMPLOYED FOR ELECTRO-PLATING AND GILDING.

The following method of recovering gold and silver from the fluids employed in electro-plating and gilding is described by Prof. Bolley, in the "Centrablatt," (German magazine of science.)

The cyanide of gold, dissolved in an excess of cyanide of potassium, resists most means of separation; even sulphuretted hydrogen produces no precipitate in it. The complete separation of the gold cannot be effected in the humid way; and this has given rise to the propositions of Bottcher, Hessenberg, Elsner and others, to evaporate the fluid, mix the dry residue with an equal quantity of litharge, fuse the mixture at a strong red heat, and dissolve the lead from the fused mass by hot dilute nitric acid; by this means the gold is left as a loose sponge. A more recent proposition is that of Wimmer, by which the mass left by evaporating the fluid to dryness on the water-bath is mixed with one and a half times its weight of nitrate of potash, and thrown in small portions into a red-hot Hessian crucible. The explosions must be waited for, and the process continued until the entire mass runs smoothly. The first process has nothing against it, except the necessity of a strong fire and the employment of nitric acid; the second, on the contrary, is very unpleasant and unsafe in its performance. It is sufficiently well known that there is no substance with which nitrate of potash detonates so violently when heated as with cyanide of potassium. If the portions of the mixture employed be only a little too large, very violent explosions are produced, which cannot take place without loss.

The following process may be adopted in small operations with a platinum crucible over a spirit-lamp. The dried mass of salts is mixed with an equal quantity of powdered muriate of ammonia, and gently heated. The ammoniacal salts decompose the cyanides of the metals, forming cyanide of ammonium, which is decomposed and volatilized, whilst the acid of the ammoniacal salt or the halogen combined with the ammonium unites with the metal which had been combined with cyanogen. In the present case, muriate of ammonia forms chloride of potassium, chloride of

iron (when ferro-cyanide of potassium has been employed) and chloride of gold. The latter is readily decomposed with formation of metallic gold; the other, at least partially, with separation of peroxide of iron, in fine crystalline scales. Undecomposed chloride of iron, as well as chloride of potassium, may be extracted with water after complete decomposition, for which a slight red heat is sufficient; the gold forms a coherent spongy mass; the iron fine light scales, which are readily separable by mechanical means. If any gold remain in the form of dust with the peroxide of iron, it may be dissolved out with nitromuriatic acid, (the calcined oxide of iron long resisting the action of the acid,) and the gold thrown down by protosulphate of iron. In most cases this mode of separation will be unnecessary. The author has convinced himself, by the employment of measured volumes of the same solution of gold, evaporation, heating with muriate of ammonia, and so forth, that even the quantity of gold in such solutions may be determined with sufficient exactness.

The same process may be adopted with plating fluids; chloride of silver is obtained, together with oxide of iron, from the ferro-cyanide of potassium; the chloride is readily dissolved by ammonia; metallic silver, of which, however, but little or none is formed, is extracted by nitric acid. It is unnecessary to say that the residue is operated upon in the usual manner to obtain the silver; nevertheless, as the decomposition of the plating fluids may be effected in the humid way by means of sulphuretted hydrogen, this process may not be so frequently adopted for silver.

Lastly, it may be useful to inform those persons who occupy themselves with electro-plastic processes, that the employment of chloride of ammonium or a salt of ammonia in this manner furnishes a ready means of testing the composition of such fluids as are used in the formation of a galvanic coating. For solutions of copper, the author employs sulphate of ammonia, because, when muriate of ammonia is employed, chloride of copper is formed, which is partially volatilized with the undecomposed sal-ammoniac, producing a loss of copper.

A NEW SOLVENT FOR COLLODION.

MM. E. Mathew Plessy and Iwan Schlumberger have proposed wood spirit, or methylic alcohol, as a substitute for ether for dissolving collodion. For this purpose it has many advantages; as it is not so volatile as ether, a thicker and more uniform coat can be applied on glass for photographic purposes. The solution of collodion thus prepared is capable of dissolving a much larger quantity of iodide of potassium than an ethereal solution, and will consequently yield a more sensitive coating. The only inconvenience attending the use of wood spirit, and which it is important to notice, is, that, during its slow evaporation from the surface of glass, &c., a certain quantity of formic acid is produced. By adding a little alcohol of sp. gr. 40° to the wood spirit, and gently warming the glass plate upon which the coating is to be put, the formation of the acid may be obviated.

The low price of wood spirit will, we are sure, induce many photographers to test the matter. — *Bulletin de la Société Industrielle de Mulhouse.*

ON THE DETECTION OF BLOOD, CONSIDERED IN A CHEMICO-LEGAL POINT OF VIEW, BY M. MORIN, PROFESSOR OF CHEMISTRY AT THE MEDICAL SCHOOL OF ROUEN, FRANCE.

The existence of blood on the clothes of an assassin constitutes one of the most important problems of judicial chemistry. The action of reagents and the power of the microscope, in many cases, demonstrate the presence of the organic liquid, provided that the criminal has not washed his clothes with the precautions that science has placed at his disposal, or else that the blood deposited on the bodies which have served him as supports has not undergone putrid fermentation, so as to destroy its characteristic materials.

The assassin, in his haste to destroy that which is frequently an essential portion of the evidence against him, washes his clothes with boiling water, sometimes even with the addition of soap, with a view of hastening the disappearance of this indubitable evidence of his crime; whence results the fixation of certain matters of the blood on the tissue. This liquid, thus concreted, gives to the stained part a greater consistence than that of the tissue itself, and forms stains of a more or less deep-brown color. These stains are of two kinds; sometimes they arise from a jet of blood, at others they are imbibed; sometimes the former have, so to speak, a spheroidal form, and this happens when the blood faces on a tissue provided with small fibrils which retain it, and seem to be opposed to its juxtaposition, by favoring its coagulation. If, on the contrary, the tissue is free from nap, the vital fluid, by retaining for a longer time its temperature, and in some measure its vitality and its fluidity, forms stains by imbibition. Whatever may be their state, when they are washed at a temperature higher than albumen coagulates they present the same color.

The ordinary means of demonstrating the presence of blood upon a tissue consist in the immersion of the stains in distilled water, with a view of obtaining a solution of this coloring matter with some proteic elements; but this method of investigation is impracticable in the case of stains which have been washed with boiling water. To solve this problem we have made some experiments, which we now communicate. We received human blood, issuing from a vein, upon linen; the tissue was immediately saturated with that liquid, and after some hours' exposure to the air stains were obtained, which were more consistent than the other portions of the tissue. They were washed with water at a temperature above that required for the coagulation of the albumen. The stains thus acquired a duller tint than they had previously. After this washing in ordinary water, they were subjected to the action of boiling water containing soap, and finally to that of cold water, until the liquor was no longer milky. In

this state, and after desiccation, they were examined. Their consistence was always superior to that of the tissue itself; the washings had not perceptibly dissolved the elements of the blood. We then detached with the scissors some of these stains, which we reduced into small strips, which were suspended in distilled water. After long immersion the liquid was not colored, and agitation did not develop in it any streak which could render evident the solution of a body of greater consistency than the liquid employed. The application of heat did not determine any opalescence indicating the solution of the least trace of albumen.

The course to be followed for indicating the existence of this organic liquid coagulated on the tissue, owing to the washing performed by the criminal, consists in putting the stains in contact with a weak solution of pure potassa; and, after reacting for some time, a liquor is obtained, which is precipitated white with nitric acid or with pure hydrochloric acid, which indicates the solution of one or more of the matters of the blood. By this alkaline treatment the stain loses some of its color, but what then is the body which is found in some measure indelibly fixed on the tissue? To solve this question, it is only necessary to put the stained tissue in contact with pure hydrochloric acid, which dissolves the matter of the stain, and forms a solution which, carefully reduced to dryness, furnishes a residue having the property of acquiring a very clear blue color, with ferro-cyanide of potassium, and a blood-red color, with sulpho-cyanide of potassium. These characters evidently demonstrate in washed blood-stains the presence of iron, which is always present in the blood. From the foregoing, when the chemist is enabled to establish in washed blood-stains the simultaneous existence of iron and a proteic element of the blood, it furnishes to the prosecution a new elcment of proof of guilt.—*Jour. de Chémic Medical.*

METHOD OF EXAMINING BUTTER.

The method of examining butter here described is only of use for the determination of its commercial value; it is calculated to enable a comparison of several samples of butter to be effected in a short time. The following instruments are required:—

1. For measuring the butter, a cylindrical glass tube, about two and one-half inches long and two lines wide, and open at both ends, is employed. It is ground in a conical form at one end, and flat at the other. Into this is passed a cork, attached to an iron wire, which closes the tube almost air-tight, but can be readily pushed through it. When in use, the cork is drawn back to the flat end of the tube, which is then filled by sticking it into a mass of butter; care must be taken to prevent the intrusion of air between the portions of butter. A mark is made on the tube, to indicate the quantity of butter to be employed in the examination.

2. A graduated tube, five and one-half inches long, two and one-half lines wide, closed at one end, and ground off at the other, is divided at the

lower portion into ten equal parts, in such a manner that these ten parts may represent exactly the volume of butter contained in the other tube to the mark. In order to find this volume, the butter measure is to be filled with water, whilst the stopper is placed exactly at the mark; the water is then poured into the tube to be graduated; and after waiting for half a minute, to make sure that all the water has collected, its level may be marked with a file, the height of water being taken to its lowest point in the middle of the tube. The space below this mark is then divided into ten equal parts, and marked with a file. Another file mark is made, three and one-half inches above the graduation.

To test butter by means of this instrument, the measure is to be filled, as above described, by inserting it to a little above the mark. This is effected with thin pieces of butter, by inserting the tube perpendicularly into the butter on a plate, until the edge of the tube comes in contact with the plate. The tube is then drawn back, and the stopper pushed down until the butter projects a little beyond the edge of the tube; and this operation is repeated until the tube gradually fills up. The mouth of the tube is then closed with the finger, and the cork pressed upon the butter until it is completely united; the cork is then pushed exactly to the mark, and the projecting portion of the butter scraped off. In this manner the presence of air is avoided. The butter-measure is then put over the open end of the graduated tube, and the butter pushed out of it by the stopper. The latter is then filled up to the mark with pure anhydrous ether, in which the butter is dissolved by shaking, the open end of the tube being closed by the finger. In about half a minute all the fat dissolves in the ether, whilst the impurities, such as buttermilk and water, are seen floating in the form of flakes, or drops. If the tube be then left standing, all these impurities settle completely, in about twenty-four hours, to the bottom of the tube, forming a stratum the thickness of which may be ascertained by the divisions of the tube. Each division, as may be ascertained by experiments conducted in other ways, corresponds pretty exactly with ten per cent. of impurities, whether there be water or other substances; and as half degrees may be easily marked, the quantity of butter may be determined to five per cent., or even more, exactly.

Middling samples of butter deposit a stratum of two degrees; they consequently contain eighty per cent. of butter, and twenty per cent. of impurities; in bad samples, which were still regarded as salable, the stratum was not more than two and one-half degrees, and one sample even showed four degrees, containing consequently only sixty per cent. of butter, and forty per cent. of impurities.—*Polytechn. Jour. CXXX. p.* 374.

SOLIDIFIED MILK.

A method of making solidified milk, as adopted with success by Mr. Blatchford, of Armenia, Dutchess Co., N. Y., is thus described in the New York Medical Journal for October, by Dr. Doremus:—

"To 112 pounds of milk 28 pounds of Stuart's white sugar were added, and a trivial portion of bicarbonate of soda, a teaspoonful, merely enough to insure the neutralizing of any acidity, which in the summer season is exhibited even a few minutes after milking, although inappreciable to the organs of taste. The sweet milk was poured into evaporating pans of enamelled iron, embedded in warm water heated by steam. A thermometer was immersed in each of these water-baths, that, by frequent inspection, the temperature might not rise above the point which years of experience have shown advisable. To facilitate the evaporation,—by means of blowers and other ingenious apparatus,—a current of air is established between the covers of the pans and the solidifying milk. Connected with the steam engine is an arrangement of stirrers, for agitating the milk slightly while evaporating, and so gently as not to *churn* it. In about three hours the milk and sugar assumed a pasty consistency, and delighted the palates of all present. By constant manipulation and warming, it was reduced to a rich, creamy-looking powder, then exposed to the air to cool, weighed into parcels of a pound each, and by a press, with the force of a ton or two, made to assume the compact form of a tablet, (the size of a small brick,) in which shape, covered with tin foil, it is presented to the public."

The doctor adds :—

"Some of the solidified milk which had been grated and dissolved in water the previous evening was found covered with a rich cream ; this, skimmed off, was soon converted into excellent butter. Another solution was speedily converted into wine-whey, by a treatment precisely similar to that employed in using ordinary milk. It fully equalled the expectations of all ; so that solidified milk will hereafter rank among the necessary appendages to the sick room. In fine, this article makes paps, custards, puddings, and cakes, equal to the best milk ; and one may be sure it is an unadulterated article, obtained from well-pastured cattle, and not the produce of distillery slops—neither can it be *watered*. For our steamships, our packets, for those travelling by land or by sea, for hotel purposes or use in private families, for young or old, we recommend it cordially as a substitute for fresh milk."

INFLUENCE OF CHEESE ON DIGESTION.

As a digester, as some not appropriately call it, cheese—that which is decayed and mouldy being preferred by connoisseurs—is often eaten after dinner. The action which experience seems to have proved it to possess, in aiding the digestion of what has previously been eaten, is both curious and interesting, and has had some light thrown upon it by recent chemical research. When the curd of milk is exposed to the air in a moist state for a few days at a moderate temperature, it begins gradually to decay, to emit a disagreeable odor, and to ferment. When in this state, it possesses the property, in certain circumstances, of inducing a species of chemical

change and fermentation in other moist substances with which it is mixed or is brought into contact. It acts after the same manner as sour leaven does when mixed with sweet dough.

Now, old and partially decayed cheese acts in a similar way when introduced into the stomach. It causes chemical changes gradually to commence among the particles of food which has previously been eaten, and thus facilitates the dissolution which necessarily precedes digestion. It is only some kinds of cheese, however, which will effect this purpose. Those are generally considered the best in which some kind of cheese mould has established itself. Hence the mere eating of a morsel of cheese after dinner does not necessarily promote digestion. If too new, or of improper quality, it will only add to the quantity of food with which the stomach is already overloaded, and will have to await its turn for digestion by the ordinary process.—*Chemistry of Common Life.*

GUANO.

At a meeting of the Society of Arts, some interesting statistics relative to guano were presented by Mr. Horace Green.

Guano is generally understood to have been brought to the notice of Europeans by Humboldt in 1804. It was first brought to England as merchandise in 1839. It had, however, been used in Peru for 600 years. Of this excrementitious matter voided by sea-birds, a very large proportion was decomposed before the guano of commerce was extracted from its beds, and more still before its arrival in port. Proof of the rapid depreciation of guano in keeping might be found in the analyses of the dung of birds by Sir Humphrey Davy and M. Coindet. Coindet found in recent excrement 8.61 of pure ammonia, and of ammonia in the form of its equivalent of uric acid 35.20, making a total of 43.81 per cent. Davy found that the soluble matter of the dung of pigeons decreased from 23 per cent. in the recent excrement to 16 per cent. in that of six months old, and to eight per cent. after fermentation. It appeared that in five years (1845–50) nearly 650,000 tons of guano had been brought almost round the world for the stimulation of the soils of this country; but it was generally believed that the zenith of supply from Peru was past. From the mean of many analyses of different varieties, it was stated that the amount of ammonia was, in Saldanha Bay, 1.68 per cent.; in Patagonia, 2.55 per cent.; in Cape and Algoa Bay, 2.00 per cent.; and in the New Islands, 1.96 per cent.; but in phosphate of lime, which was the next most important element, the guanos were richer as they were poorer in ammonia. The mean amount of phosphate of lime was, in Saldanha Bay, 55.40 per cent.; in Patagonia, 44.00 per cent.; in Cape and Algoa Bay, 20.00 per cent.; and in the New Islands, 62.80. The question, however, arose, whether or not large quantities of such manures could be sold at a price which should not exceed the home cost of super-phosphate of lime. Reference was then made to the Guano Substitute Prize of

1000*l.*, and the Gold Medal, which were offered by the Royal Agricultural Society for the discovery of a manure equal in its fertilizing properties to Peruvian guano, and which could be sold at a price not exceeding 5*l.* per ton; and it was contended that, as; according to the composition of guano as given by Professor Way, and the known value of these several articles in the markets of commerce, the value of a ton of such material would be upwards of 12*l.*, it was not at all probable that any one would dispose of it for 5*l.* The author then proceeded to describe the fisheries guano of Mr. Pettit, and gave the results of several analyses, from which it was deduced that, according to the scale before alluded to, the mean value of the samples tested was 9*l.* 7*s.* 7*d.* per ton. The manufacture of this guano on a large scale would be carried on by a process of the following nature: A given weight of fishy matter was placed in a large tank, and sulphuric acid of commerce added to the mass. The action of the acid was so powerful as speedily to reduce the organic matter to a soft pulpy consistency, resembling in appearance the fecal matter of birds. This pasty mass being placed in a centrifugal drying machine, and the superabundant moisture forcibly driven off, the partially dry matter was now submitted to a heat not exceeding 212° Fahrenheit, and afterwards pulverized in a suitable manner. In this process the oily matter of the fish separated itself and swam upon the surface of the liquid; hence it could be easily separated, and formed an important item in the economy of the manufacture — since, taking all kinds of fishy matter, we obtained an average of three per cent. of oil, worth 25*l.* per ton, or three-fourths of the whole expense of the raw material. Another process might in some cases be adopted with advantage, especially with cartilaginous fish. As to the supply of the raw material, it was believed, from the testimony of many persons on the coasts, that an ample supply of refuse fish would be obtained at an average price of 1*l.* per ton; and taking 60 tons of this weekly, the cost of manufacture and incidental expenses would be 10,643*l.* per annum. From this there would result 93 tons of oil, which, at 25*l.* per ton, would give 2,325*l.*, and 1,653 tons of guano, at 7*l.* per ton, or 11,571*l.*, making together 13,896*l.* as the amount of sales, or as profit of 3,253*l.*

It was stated that some years ago an inquiry was instituted as to whether the offal and refuse fish of Newfoundland could not be prepared into a manure at a *cheaper rate* than that already in the market, when it was found that there were difficulties in the way, which led to the abandonment of the idea.

BRITISH AGRICULTURE.

At the London Society of Arts, Mr. Mechi presented a communication, in which he called attention to the new method of irrigation as practised successfully by him, which involved in its consideration our water supply, sanatary condition and physical support, and the application of steam to

cultivation. Nearly the whole difference between this balance sheet and the former one arose in the life stock account. By irrigation he was enabled to double, if not triple, his green and root crops, and thus render them profitable instead of unprofitable. It was quite clear that if he could double his stock he doubled the quantity of his manure, and thus affected importantly the cereal crops. If he doubled his green and root crops, he would diminish their cost one-half. This was actually the fact, and therein was his present and most agreeable position. Every practical farmer knew that the losing part of his farm was the root crop, it costing him more than the animal repaid, and leaving a heavy charge on the ensuing grain crops. Irrigation changed all this, and permitted each crop to be responsible for its own annual charge, thus rendering them all remunerative. Professor Way, in his recent analysis of grasses in the "Royal Agricultural Society's Journal," had revealed the astounding truth, that irrigated grasses contain twenty-five per cent. more meat-making matter than those not irrigated. We know by our great chemists that our sewers contain the elements of our food, of, in fact, our very selves, and that to waste them as we now do was a cruel robbery on the welfare and happiness of our people. Practical experience has taught Mr. Mechi that the sewerage was all the better for ample dilution; that the more you flood your cities with limpid streams, washing from every tainted and poverty-stricken court and alley the elements of pestilence and suffering, the grateful earth will absorb them in her bosom, and return them to you as treasures of health and strength. When he spoke of liquefied manures, he must be understood as meaning all excrementitious matter, solid or liquid, rendered fluid or semi-fluid by the addition of water, or by decomposition in water. In dealing with quantities of such decomposing matter, a disagreeable and unhealthy effluvia would arise, however small the trap or cover of the tank; but experience had at length taught him that a jet of waste steam admitted into the tank above the agitated mass of putrefaction effectually prevented any noisome odor. To irrigate a farm of 200 acres you would require—four-horse steam power; fifteen yards per acre of three-inch iron pipe; a circular tank, about thirty feet in diameter and twenty feet deep; two hundred yards of gutta percha two-inch hose; a gutta percha jet; and a pair of force pumps, capable of discharging 100 gallons per minute. At present prices, all this could be effected at about 6*l*. per acre, so that the tenant paying 9*s*. per acre to his landlord for such an improvement would be a great gainer. While touching on irrigation, it might be useful to consider drainage, with which it had a close connection. Of course, without drainage, natural or artificial irrigation would be injurious. There could be no doubt as to the necessity for tapping sand or peat pots, or other natural and free receivers of water, when surrounded by tenacious clays. Up-and-down drains would generally do this; but where they did not, lateral branches might be added. Every farmer with 200 or 300 acres, who had not a steam engine, had a great lesson to learn, as a good four-horse power steam engine would tire any sixteen real horses that could be found, the comparative cost being

150*l.* against 600*l.*, besides eating nothing when not at work, occupying less space, and economizing an immense outlay in casualties by disease, cost of attendance, and daily food. The author then alluded to Mr. Romaine's steam cultivator, and to Mr. Usher's steam plough, both of which he thought might yet be made sufficiently powerful to work thirty or forty acres, or even 100 acres, a day. The former machine would, if required, deposit the seed and roll the land at one and the same time; and when not cultivating, it would be available for driving the threshing-machine, mill-stones, irrigating pumps, chaff and turnip-cutters, cake-breakers, &c., requisite on most improved farms. It was also intended to work a reaper at harvest. The new American threshing-machine was considered to be an implement that would supersede all ours in cost, utility, lightness, durability, and general enconomy; but instead of working it by horse power, as had been proposed by their Yankee friends, he had attached a small portable steam engine of four-horse power to the machine, and proved its advantage over a relay of eight horses.

ON THE SEWERAGE OF MANUFACTURING TOWNS.

The analysis, made by Dr. Wrightson, of a natural deposit from the sewerage of Birmingham, formed near the embouchure of several sewers opening into the Rea, showed the absence of all ammoniacal salts and the scarcity of phosphates, particularly alkaline phosphates, and, at the same time, the presence of a large quantity of protoxide of iron, also of zinc, copper, and other metals in the state of oxides and sulphurets. These metallic salts, in the sewers, absorbed the sulphuretted hydrogen and ammonia generated by decaying vegetable and animal matter, and, doubtless, contributed to promote the health of the town. The deposit contained when dried only 1.4 per cent. of nitrogen (not as ammonia) and 3.5 of earthy phosphates; but about 11.7 of protoxide of iron, besides zinc, copper, and other metals to the extent of two or three per cent. — *Proc. British Association.*

ON THE EQUIVALENCY OF STARCH AND SUGAR IN FOOD.

The following is an abstract of a paper presented to the British Association, 1854, by Messrs. Lawes and Gilbert. At the meeting of the British Association at Belfast the authors had given a paper "On the Composition of Food in Relation to Respiration and the Feeding of Animals," in which they had illustrated, by reference to experiment, that, as our current food-stuffs go, it was the amounts they supplied of the assimilable non-nitrogenous rather than those of the nitrogenous constituents, which measured both the amounts consumed by a given weight of animal, within a given time, and the amount of increase obtained from a given weight of food. The results, which formed the subject of the present communication, afforded further illustration of some of the points brought forward

in the former one; but they had been arranged with reference to certain practical questions as well as to the more scientific bearings of the subject. Thus, those interested in the growth of sugar had long wished to obtain the introduction of the lower qualities of that article, for feeding purposes, duty free. The subject of the remission of the malt-tax, for the same object, had also frequently been agitated. According to the results of experiment, (numerous tables of which were exhibited in the room, and in which the animals had been made to rely for about one-third of their total food upon the starch or sugar employed,) it appeared that absolutely identical amounts of the dry substance of the starch and sugar, which had thus been tried against each other, had been both consumed by a given weight of animal within a given time, and required to yield a given weight of increase. The identity, therefore, in feeding value, which had, from the known chemical relationship of these two substances, been hitherto assumed, was thus experimentally illustrated. If, therefore, sugar had no higher feeding value than starch, the relative prices, weight for weight, of sugar and the starchy grains generally used for feeding purposes, but which also supplied the needful nitrogenous constituents, would afford an easy means of estimating the probable economy of the use of the former. These new results were also consistent with direct experiments, published by the authors some time since, "On the Comparative Feeding Value of Malted and Unmalted Grain." It was true that malt and other saccharine matter might serve, in some degree, to give a relish to the food, and thus induce the animal to consume more, which in "fattening" is always a consideration; but this incidental benefit could not counterbalance much increased cost: hence, it did not seem probable that any extensive use of malt for feeding purposes would be such a boon as had been supposed. The proved equivalency of starch and sugar in food was also of interest in reference to some other of the views maintained by the authors in their former paper. Thus, it had been shown that a fattening animal might store up very considerably more fat than existed ready formed in its food; and this produced fat was doubtless, in a great measure, due to the starchy and saccharine substances, which constitute so large a proportion of the non-nitrogenous constituents of our staple vegetable foods. It was these, too, which, in practice, served largely to meet the requirements of the respiratory function, which it had been shown, under ordinary circumstances, measured to such an extent the amount of food demanded by the animal system.

ON THE RELATIVE VALUE OF DIFFERENT KINDS OF MEAT AS FOOD.

M. Marchal took twenty grammes of the muscles of the pig, ox, sheep, calf, and hen, which contained neither sinews nor cellular tissue, nor adhering fat, except what naturally exists between the muscular fibres, and

dried them in a water bath for several days, and thus ascertained the loss which each sustained by desiccation :—

	FIRST EXPERIMENT.		SECOND EXPERIMENT.	
	Solid Matter.	*Water.*	*Solid Matter.*	*Water.*
Pork, . . .	29.45	70.55	30.25	69.75
Beef, . . .	27.70	72.30	27.50	72.50
Wether mutton, .	26.55	73.45	26.35	73.65
Chicken, . .	26.35	73.65	26.30	73.70
Veal, . . .	26.00	74.00	25.55	74.45

According to these numbers, we should arrange the meats in the following order of their relative nutritive powers : pork, beef, mutton, chicken, veal. This order is, however, not the true one ; because the leanest meat contains a certain amount of fat, and because this substance is not so important an article of food as the pure muscles, it is necessary to ascertain how much a certain quantity of meats contain before we can judge properly of its relative nutritive value. M. Marchal accordingly treated the dried flesh with ether to dissolve out the fat, and obtained the following results :—

	Fat soluble in ether.	*Pure muscle insoluble in ether.*
Beef, ...	2.54	24.95
Chicken, ...	1.40	24.87
Pork, ...	5.97	24.27
Mutton, ...	2.96	23.38
Veal, ...	2.87	22.67

The last table shows that the true order should be beef, chicken, pork, mutton and veal, a result which experience confirms. It may, however, be remarked, that there is considerable difference between the same kind of meat derived from different animals, and that the same amount of two different kinds of beef broth, both containing the same amount of water, may have different nutritive values.—*Comptes Rendus de l'Académie.*

ON THE VALUE OF PHOSPHATE OF LIME IN NUTRITION.

In the *Bulletin de l'Académie Impériale de Médecine*, for January, 1854, we find a report by M. Mouriès, in regard to the effects of phosphate of lime in the nutrition of animals, and the influence which the judicious employment of this salt is capable of exercising upon the mortality of children in large cities.

It has been a comparatively short period since physiologists began to appreciate properly the importance of inorganic principles in the phenomena of life. The farther we penetrate into this complex problem, the greater is the importance attributed to bodies, the presence of which in the human organism was regarded as quite accidental.

Very dissimilar organic compounds may be substituted for each other

in our diet without any disorder in the general harmony, but the inorganic principles can only be replaced by substances very closely analogous to them. Albumen, fibrin, and casein, and other more complex aliments, though differing in origin and composition, may fulfil the same physiological end, but it is different with inorganic principles. Lecanu has shown that iron is indispensable for the proper constitution of blood-globules; chloride of sodium is of primary importance also as a constituent of the liquor sanguinis; and it is only as an exception that we find, in certain gramnivora, this salt partially replaced by the phosphate of soda or of potash. Liebig has shown that the chloride of potassium of the muscles cannot be replaced by chloride of sodium. Each inorganic constituent of the organism has, therefore, its definite and limited sphere of action, to which it is exclusively adapted.

Among the indispensable inorganic salts, the phosphate of lime holds an important rank. M. Mouriès has devoted himself to the elucidation of its peculiar action. He deduces from his experiments the following conclusions:—

1st. Phosphate of lime plays a more important part in nutrition than has heretofore been believed. Independently of its necessity as a constituent of bone, this salt maintains that irritability without which there is no assimilation, and consequently no nutrition. Its insufficiency, therefore, produces death with all the symptoms of inanition, while its insufficiency in a less degree produces a series of lymphatic diseases.

2d. The food consumed in cities is deficient in this respect. Nurses' milk has, consequently, the same defect. The infant as well as the fœtus suffers from the deprivation of this element, so indispensable to its development and life. Hence one of the causes of the increase in the number of still-born children, and of the mortality of infancy.

3d. The addition of this salt, in combination with animal matter, to alimentary substances, obviates one cause of disease and death.

The following are the principal facts on which M. Mouriès relies to establish these conclusions:—

The blood of animals contains a constant proportion of earthy phosphates, which is independent of their ingesta. The pigeon ingests phosphate of lime slightly in excess in the grain and calcareous gravels which it picks up; the horse swallows an excess in its fodder; the dog procures a still greater excess from the bones on which it is fed; and yet the blood of the pigeon contains in 1000 grammes 1.20 of phosphate of lime; the horse 0.5; the dog 0.4. This result is not accidental; all birds whose blood has been analyzed have 1.5 to 1.2 of phosphate of lime, while the proportion in the blood of the carnivora and herbivora varies from 0.9 to 0.4. The proportion thus regulated by Nature is modified by age and sex. The bull, cow and calf have the same food, yet their blood contains respectively 0.5, 0.9, 0.8 of phosphate of lime.

The requisite proportion of alkaline phosphates varies, therefore, in different animals. A pigeon weighing one pound died at the end of ten months, during which period he was fed daily on one oz. of wheat, with

common water for a drink, by which rather more than a grain of phosphate of lime was ingested daily: on the other hand, a woman weighing 100 pounds enjoyed perfect health upon a diet which furnished her daily with 90 grains of phosphate of lime—thus health in the one case, and death in the other, with relatively equal quantities of this salt.

We shall recur to this example to show how complex are the conditions of these experiments, and what reserve is necessary in drawing conclusions from them.

M. Mouriès asserts, and the fact has already been noted by Chossat, that if the proportion of alkaline phosphates of the food is deficient, there ensue atony of the digestive organs, imperfect assimilation, and death. To prove that pigeons die from want of phosphate of lime, we may observe that their death is hastened if they are allowed only distilled water, while their lives may be preserved by adding earthy phosphates of their food.

M. Bouchardat observed that the grain on which MM. Mouriès and Chossat fed their pigeons contained only traces of common salt. The birds therefore should be expected to suffer from the deprivation of this principle. M. Bouchardat accordingly made this experiment; he confined two pigeons, and fed them on dried grain. In two months the health of the female became impaired; she suffered from thirst and diarrhœa, and laid no more eggs. She was set at liberty. She flew immediately to a window-sill impregnated with alkaline chlorides, and began to peck eagerly; there was a larger quantity of salts on the interior of the window frame; the pigeon entered through the open window, and permitted herself to be recaptured, so imperious was her demand for these principles. Her health was reëstablished; in three days she laid another egg. It is wrong, therefore, to conclude, with M. Mouriès, that a deficiency of phosphates is the only cause of the symptoms he observed; in this case, the absence of chlorides was the obvious cause.

M. Mouriès has established, by interesting calculations, that grain furnishes a sufficient supply of phosphate of lime for the reparation of bone, but not for other essential functions of the economy. From the curious fact that there is a constant proportion between the temperature of animals, and the amount of phosphate of line contained in their blood, he deduces the principle that this salt keeps up animal irritability, without which nutrition is impossible. The following table presents some interesting facts in physiology:—

	Phos. Lime.	*Temperature.*
Blood of the Duck,	1.50	42° 5 centigrade.
" " Hen,	1.35 to 1.25	41° 5 "
" " Pigeon,	1.20 " 1.23	40° "
" " Man,	0.80 " 0.6	37° 5 "
" " Horse,	0.40 " 0.5	36° 8 "
" " Frogs,	a trace,	9° "

If these results are confirmed, it will appear that the ingestion of phosphate of lime is not only indispensable for the reparation of bone, but that it is connected with the function of calorification.

ON THE PROXIMATE PRINCIPLES OF THE BRAN OF WHEAT.

Some years since, M. Millon, as a result of long labor, arrived at the conclusion that *bran is an alimentary substance;* that bran bread and pilot bread was more healthy and more nutritious than white bread. This opinion has been contested, and Millon has been ironically attacked for not conforming to the regimen he recommends. But the opinion is now sustained by Chevreul, who declared his views on the occasion of a memoir of M. Mouriès on this subject. It is known, too, that, according to Magendie's experiment, dogs could live on bran bread, whilst they died when kept on wheat bread. This fact, which appears singular, is explained through the researches in question.

The inner surface of bran is covered with azotized principles, which, like diastase, will dissolve starch, changing it into dextrine and sugar. These principles differ somewhat from diastase. Still it is demonstrated that bran acts as a ferment in fermentation, and consequently in a similar manner in digestion. — *Silliman's Journal, Paris Correspondence.*

ON THE RESULTS OF EXPERIMENTS ON THE PRESERVATION OF FRESH MEAT.

This inquiry, presented to the British Association by Mr. G. Hamilton, was undertaken with a view of discovering a method by which beef could be brought in a fresh state from South America. The experiments were made by enclosing pieces of beef in bottles containing one, or a mixture of two or more of the following gases — chlorine, hydrogen, nitrogen, ammonia, carbonic acid, carbonic oxide, and binoxide of nitrogen. Of these, the last two only possessed the power of retarding putrefaction. Beef that had been in contact with carbonic oxide for the space of three weeks was found to be perfectly fresh, and of a fine red color. Binoxide of nitrogen is capable of preserving beef from putrefaction for at least five months, during which time the beef retains its natural color and consistence. When meat that had been preserved by the last process was cooked by roasting, it was found to possess a disagreeable flavor. If cooked by boiling, the ebullition must be continued for a much greater length of time than is necessary for fresh meat.

Dr. Calvert remarked, that he had opportunities of observing the well-known valuable anti-putrid properties of carbolic acid, and instanced the case of the carcass of a horse that was at present in a fresh state, although four years had elapsed since it had been soaked in liquor containing the acid. He recommended the use of this acid for preserving bodies intended for dissection, as it neither affects the tissues nor discolors the organs.

ON THE AMOUNTS OF AMMONIA AND NITRIC ACID IN RAIN WATER.

At the British Association, Dr. Gilbert and Mr. Lawes communicated the results of their investigations on the amounts of ammonia and nitric acid in rain water. Their results during many months of the last two years were tabulated and compared with those of Boussingault; the great result being, that rain water contains not quite one part of nitrogen to the million in the form of ammonia, and about five parts to the million in that of nitric acid. The ammonia is found in largest quantity in mists and dews, as might naturally be expected from its being evolved at the surface of the earth, and being absorbed by any moisture. In answer to questions put to him afterwards, Dr. Gilbert stated that the nitric acid was found most abundantly after storms, and varied very greatly at different periods of the year. The amount of ammonia which descended in a month's rain was more constant. The doctor expressed his opinion, but with hesitation, that nitric acid and ammonia were about equally efficient in supplying nitrogen for plants; and therefore, as nitric acid is the more abundant in the atmosphere, he conceived that it afforded actually the larger quantity of azote to the vegetable world.

Boussingault has recently published some additional researches on the above subject, from which it appears that the rain of the country contains less ammonia than that of the city, and that the ammonia is more abundant at the beginning than at the end of a shower. He has also examined the dew, and always found it to contain ammonia. The proportions by several trials were six milligrammes to the litre; but the amount is reduced to 1.02 after a rainy day. On the 14th to the 16th of November a thick mist prevailed, so rich in ammonia that the water had an alkaline reaction; a litre of the water contained about two decigrammes of carbonate of ammonia. Seventy-five rains, including the dew and mist, examined, contained as a mean half a milligramme of ammonia. The great quantity of ammonia contained in the mist appears interesting in its bearing on vegetable pathology; in fact, although ammonia in small quantity is favorable to vegetation, a large proportion would be injurious, and would show its effects, especially on the leaves of flowers. Moreover, such a storm might have a deleterious influence upon respiration, and especially on the lungs of persons with pulmonary affections.

ON THE ABSORPTION OF NITROGEN.

A debate of great interest has been entered into in the French Academy, between M. Boussingault and M. Ville, respecting the absorption of nitrogen by plants, which has been conducted with unusual interest, and some acrimony.

The question discussed by these gentlemen was this: May we ascertain whether or not vegetables possess the faculty of directly absorbing, to

their advantage, a portion of this gaseous azote which forms the greatest part of the atmosphere? The importance of the question is evident: if the free and gaseous azote may directly enter into vegetable organism without passing through some intermediate combination, the veritable source of agricultural wealth is in the atmosphere; if, on the contrary, before the azote commingles with the plant, it must unite itself to some other element, the agricultural chemist must turn his attention to the search of some new and better method of favoring the slow and difficult formation of combinations of azote. In both of the hypotheses the importance of manure remains incontestable, but their functions will not be so important. If azote gas is not capable of assimilation, if it is simply destined to temper the action of the oxygen with which it is mixed in the air, it is evident how important organic matters are in manures, bringing as they do the elements of the azotic principles elaborated by the plants. If, on the contrary, the azote of air is absorbed during the act of vegetation, if it becomes in this way an integral part of the vegetable, then the mineral substances of manures contain the greatest part of their fertilizing properties; for the azote element would have been abundantly furnished by the atmospheric air. Why, then, has the chemist not yet determined this important point, whether gaseous azote is or is not directly assimilated by plants? The great obstacle lies in the difficulties of making the experiment, which should resolve the question. When the chemist would place a plant under a definitive regimen, to ascertain what it obtains from the mineral kingdom, whence it extracts a portion of its aliment, it is indispensable to measure, to weigh, to analyze every thing—the air it respires, the water which moistens it, the soil which upholds. M. Boussingault and M. Ville use different methods, of which they are tenacious. It cannot be denied that M. Boussingault exhibits a great deal of art in the process he used in his experiments. He first abandoned the ridiculous pretension—commonly entertained before him—of measuring by default the azote a plant would have absorbed while it lived during a certain time in a limited quantity of air. He substituted in its stead, raising the plants in a completely sterile soil, and comparing the composition of the seed and the composition of the small crops so obtained at the expense of air and water alone. A handful of earth previously calcined, and watered with distilled water, evidently can furnish no organic matter to the plant which is developed there; and consequently, if, after the crop is gathered, the chemical analysis shows it contains more azote than the grains sown contained, it is manifest that this azote came by the air—this result M. Boussingault obtained by experimenting with the seed of clover and of peas.

But in communicating this result to the world, M. Boussingault did not pretend to do more than to exhibit the bare fact. He made no deduction to demonstrate that it came by the air in its normal state, or by the rare ammoniacal vapors from which the atmosphere is never exempt. M. Ville did not imitate his silence. He studied the question, and found

the azote of the crops was ten, twenty, thirty times greater than the azote of the seed. However, M. Boussingault, pursuing his researches, (using a different method,) attained diametrically opposite results, or results which are completely negative. To avoid any objection which might be urged on the ground of the permanent communication of the apparatus with the external air, he planted the objects of his experiments in a completely closed vase, and furnished them in the beginning with the quantity of carbonic acid and of water necessary to their alimentation during the whole course of their development. The apparatus was thus made extremely simple, being nothing but a large glass globe, capable of holding some sixty or eighty quarts; he placed in the bottom of the globe (after having made it sufficiently humid) a certain quantity of pumice stone, pounded, which had been washed, heated red hot, and, after it had cooled, mixed with the ashes of barn-yard manure, and of seed similar to those about to be planted. The opening of the globe was immediately covered with a cork, which was itself covered with a caoutchouc cap. Forty-eight hours after this had been done the cork was again removed, and enough pure water added to bathe the base of the pumice stone, which had been disposed in a heap. Then the seed were planted—they being inserted in a glass tube, which guided them to the place where they should lie. After the seed were introduced the globe was again closed, and, when the seed had germinated sufficiently, the confined atmosphere was charged with carbonic acid gas, by substituting in the place of the cork a second globe superposed on the first, having about one-tenth of the capacity of the first, and containing the acid gas prepared beforehand; the juncture between them was then filled with sealing-wax, and half of the apparatus was buried in the ground. The experiment was now abandoned to itself, and the experimenter had little more to do besides to observe the plants' progress, to take advantage of the opportune moment to transfer them to his laboratory. The result of M. Boussingault's experiments is, that there is no azote fixed in an appreciable quantity during the course of the vegetation: the azote of the seed passed into the plant, the azote of the air remained fixed in the air. M. Ville urges that a positive result is of more importance than a mere negative result; that he has, to sustain his position, the *gramme* of azote which he discovered in the plants he reared on a perfectly sterile soil; besides that, during his experiments, he ascertained the circumstances in which M. Boussingault placed his plants are peculiarly unfavorable to the health of the plant, and to the exercise of the function of assimilating—they pervert the function whose office they both are studying.

This discussion, although no positive results were attained, will nevertheless be read with interest.

The following is an abstract of a communication previously presented to the French Academy, by M. Ville, on the absorption of nitrogen:—

After stating that it has often been asked if air, and especially nitrogen, contributes to the nutrition of plants, and, as regards the latter, that this

question has always been answered negatively, the author remarks that it is, however, known that plants do not draw all their nitrogen from the soil, the crops produced every year in manured land giving a greater proportion of nitrogen than is contained in the soil itself. The question which he has proposed to himself for solution is, Whence, then, comes the excess of nitrogen which the crops contain, and, in a more general manner, the nitrogen of plants, which the soil has not furnished? He divides his inquiry into the three following parts :—

First. Inquiry into and determination of the proportion of the ammonia contained in the air of the atmosphere.

Second. Is the nitrogen of the air absorbed by plants?

Third. Influence on vegetation of ammonia added to the air.

1. The author remarks, that since the observation of M. Theodore de Saussure, that the air is mixed with ammoniacal vapors, three attempts have been made to determine the proportion of ammonia in the air; a million of kilogrammes of the air, according to M. Gräyer, contain 0.333 kil. ammonia; according to Mr. Kemp, 3.880 kil.; according to M. Frésenius, of the air of the day, 0.098 kil.; and of night air, 0.169 kil. He states that he has shown the cause of these discrepancies, and proved that the quantity of ammonia contained in the air is 22.417 grms. for a million of kilogrammes of the air, and that the quantity oscillates between 17.14 grms. and 29.43 grms.

2. The author states that, though the nitrogen of the air is absorbed by plants, the ammonia of the air contributes nothing to this absorption. Not that ammonia is not an auxiliary of vegetation, but the air contains scarcely 0.0000000224, and in this proportion its effects are inappreciable. These conclusions are founded upon a great number of experiments in which the plants lived at the expense of the air, without deriving any thing from the soil. For the present he confines himself to laying down these two conclusions :—1. The nitrogen of the air is absorbed by plants, by the cereals, as by all others. 2. The ammonia of the atmosphere performs no appreciable part in the life of plants when vegetation takes place in a limited atmosphere. After describing the apparatus by means of which he carried on his experiments on the vegetation of plants placed in a soil deprived of organic matter, and the manner in which the experiments were conducted, he adduces the results of these experiments in proof of the above conclusions.

3. With reference to the influence of ammonia on vegetation, the author states that, if ammonia be added to the air, vegetation becomes remarkably active. In the proportion of four ten-thousandths, the influence of this gas shows itself at the end of eight or ten days, and from this time it manifests itself with continually increasing intensity. The leaves, which at first were of a pale-green, assume a deeper and deeper tint, and for a time become almost black; their petals are long and upright, and their surface wide and shining. In short, when vegetation has arrived at its proper period, the crop is found far beyond that of the same plants

growing in pure air, and, weight for weight, they contain twice as much nitrogen. Besides these general effects, there are others which are more variable, which depend upon particular conditions, but which are equally worthy of interest. In fact, by means of ammonia we can not only stimulate vegetation, but, further, we can modify its course, delay the action of certain functions, or enlarge the development and the modification of certain organs. The author further remarks, that, if its use be ill directed, it may cause accidents. Those which have occurred in the course of his experiments appear to him to throw an unexpected light upon the mechanism of the nutrition of plants. They have at least taught him at the expense of what care ammonia may become an auxiliary of vegetation. These experiments, which were made under the same conditions as those upon the absorption of nitrogen, are then described, and their numerical results given.

To the conclusions already stated, the author adds, that there are periods to be selected for the employment of ammonia, during which this gas produces different effects. If we commence its use when several months intervene before the flowering season of the plants, it produces no disturbance; they follow the ordinary course of vegetation. If its use be commenced at the time of flowering, this function is stopped or delayed. The plant covers itself with leaves; and if the flowering takes place, all the flowers are barren.

ON THE CULTIVATION, USES, AND ANALYSES OF MADDER.

The following communication, addressed to Dr. A. A. Hayes, of Boston, by Mr. Carnes, of Lowell, has been published in the *Scientific American*:—

LOWELL, Mass.

At the request of Dr. S. L. Dana, of this city, I have made several analyses of different kinds of madder ashes, with a view to discover, if possible, the reason of the superiority of the Avignon madders. By the addition of carbt. lime, even to Turkey madders, the colors are improved in stability and brightness; the French madders, as imported ground for use, need no such addition. The object of these analyses was to show whether there existed in French madders a larger amount of carb. lime than in the other varieties.

There are several theories as to the function of the chalk; by some it is supposed to act by saturating an acid present; by others it is thought that the combination of two different bases with the coloring matter gives much more solidity to the dye, in consequence probably of a greater insolubility in the compound formed. Experiments made by M. Kœchlin — the celebrated calico printer of Mulhausen — seem to prove that in all instances of madder dyeing, under the influence of chalk, a certain amount of lime becomes added to the aluminous mordant, and in the subsequent clearing with a soap bath some of the alumina is removed, and there remains upon the fibre of the cloth a combination of the two earths, lime

and alumina, in atomic proportions, or nearly so. The madders subjected to analysis were American, Avignon, and Turkey. The American was grown in Montague, Mass., on the farm of Martin H. Clapp, and the roots used were of four years' growth. The land upon which it was grown is the "interval" lying near the Connecticut River; it was treated with twenty loads of strong green manure, and one hundred pounds of plaster to the acre; Indian corn was grown upon it the year previous to planting with madder. The next year the manure and plaster were applied as before, and the madder roots planted. The crop was cultivated the last three years in the same manner as potatoes, with the addition of one shovel full of well-rotted manure and a little plaster to each hill, late in the autumn of each year. The different samples were burned in a muffle, without regard to the percentage amount of ash which each variety yielded.

The different ashes were found to consist of

	American.	*French.*	*Turkey.*
Chlo. sodium,	2.61	3.76	4.71
Carbt. potassa,	7.45	4.40	5.50
Carbt. soda,	39.23	9.78	22.71
Silica,	8.48	25.86	27.71
Phosphate lime,	12.75	19.75	17.85
Carbt. lime,	23.39	32.76	18.35
Carbt. magnesia,	6.05	?	3.14
Alumina,	–	3.66	?
	99.96	99.97	99.97

The American madder, when treated with from 4 to 6 per cent. of chalk, gives colors every way superior to the best French. The "pinks" and "roses" stand the process d'Avisage, furnishing colors which are more "pink" and "rosy" than the French; it also furnishes a purple of a much more desirable shade than that obtained from the French. Used in equal weights, the American gives deeper colors than the French, showing a greater percentage of coloring matter. The ground French madder, as imported, will, if treated with an additional amount of carbt. lime, furnish colors which are inferior to those produced by the same article without this addition.

The French madder will, if treated with a dilute acid, effervesce strongly. This effervescence will not take place by treating any other of the ground woods or plants used in dyeing in the same way, and seems to indicate the presence of a free carbonate. The Dutch madders have always needed an addition of carbt. lime to produce brilliant and "fast" colors, but within a few years Dutch madders have been imported ground on the French process. These do not need any addition of carbt. lime. The Dutch madders, as formerly imported, will not effervesce when treated with a dilute acid. The new "Dutch roots ground on the French pro-

cess," when treated in the same manner, show evident signs of the presence of a carbonate.

It would seem as if all that is needed to obtain as good a reputation for the American madders as any in the world, is to have them ground on the French process, which, from the deportment of the different varieties of madder when treated with carbt. lime, would lead to the supposition that there is a certain amount of carbt. lime added to the best French roots during the process of grinding.

There seems to be a fair inducement for the farmers and growers of New England to cultivate madder; for although Mr. Clapp labored under many disadvantages, such as building and procuring an entire set of apparatus, drying kilns, &c., and obtaining but about one-third of a crop from his land as compared with the crops raised in Western New York, still he lost only the interest on the land cultivated.

ON THE ANALYSIS OF THE ASH OF LEMON JUICE.

In a communication to the London Chemical Society, Mr. Witt referred to the difference of opinion as to the cause of the value of lemon-juice as an anti-scorbutic, some attributing its effect to the acid, and others, with Dr. Garrod, believing that it supplied potash to the constitution of the patient. The author had found forty-four per cent. of potash in the ash, along with lime and other substances. The whole quantity of the alkali in the juice was very small, only 1.7 grains in 1000 of the liquid. Dr. Bence Jones expressed his conviction that the action of this remedy was not due to the very small quantity of potash it contained, but rather to the citric acid, which had an effect upon the system analogous to, but much less than, that of oxalic acid.

PREVENTION OF THE RAVAGES OF THE SHIP WORM.

A plan for the preservation of submerged timber from the attacks of the "worm" has been devised by Mr. Swan, of California. He claims that it is both cheap and effectual, and a committee has been appointed by the California Academy of Natural Sciences to investigate the matter. A marine railway to which it was applied remains, at the end of eighteen months, perfectly sound; while timber by its side, or the same species of wood, has within that period twice required renewal, having been fairly "riddled" by the Teredo. It is simply the application of a mixture of asphaltum, (one hundred parts,) sulphur, (forty parts,) and arsenic, (twenty parts,) used as a paint, the asphaltum being melted, the other materials stirred in, and the whole applied hot with a common brush; the wood must of course be dry. If this proves to be as effectual as the trial here seems to promise, the value of the discovery can scarcely be overrated. — *Com. to Bos. Society Nat. His., by Dr. Ayres.*

ON THE PERCENTAGE OF TANNIN IN DIFFERENT SUBSTANCES.

The following article is contributed to the *Polytechnisches Centralblatt*, by Prof. Fehling: —

Among the various substances which precipitate tannin from solution, such as gelatine, quinine, animal skin, &c., the latter has hitherto been recommended as the most appropriate for determining the percentage of tannin. This method of valuation has been preferred, because it represents in miniature the operation to which the results refer. There are, however, no detailed directions for its application; and in repeated trials made by the author, under a variety of conditions, he has found that the tannin is never perfectly precipitated, and that the solutions soon become mouldy. Experiments with solution of quinine, freshly precipitated oxide of iron or alumina, did not give more satisfactory results. He then tried gelatine in solution; and instead of weighing the precipitate obtained, by adding an excess of gelatine, preferred adopting the volumetrical method, estimating the quantity of solution of gelatine of known centigrade value required to precipitate the tannin. For this purpose, it is indispensable that the precipitate should separate readily; but with most kinds of tannin this is not the case. The author has found it advantageous to use a dilute solution of gelatine, and to have the liquids quite cold. His mode of operating is as follows: —

The solution gelatine is prepared by digesting 10 grms. of dry gelatine (containing about 18 or 19 per cent. of water) in water for twelve hours, and then applying heat until the solution is complete. The volume is then made up to 1 litre.

For the purpose of determining the centigrade value of the gelatine solution, 0.2 grm. of pure tannic acid, dried at 212° F., is dissolved in 100 or 120 grms. of water, and the gelatine solution added from a graduated burette until the precipitation is complete. Filtration is generally necessary towards the end of the operation, or, as a substitute, the following plan may be adopted: — A narrow open glass tube is covered at one end with some tolerably thick linen bound tight by a cord; on immersing this covered end in the liquid, and sucking out the air by the mouth at the other end, a portion is rendered clear by passing through the linen, and may be poured into a tube and tested with gelatine.

The author found that the 0.2 grm. of pure dry tannic acid required from 32.5 to 33 cub. centims. of the gelatine solution for perfect precipitation; when the gelatine solution is some days old, a larger quantity is necessary, 35, 38, or even 40 cub. centims. It is therefore necessary in all cases, when the gelatine solution has been kept any time, to determine its centigrade value by means of tannic acid immediately before making any experiments with it.

If it is required to estimate the value of oak or other barks for tanning, they are first dried in a warm room, powdered finely, digested in quan-

tities of 10 grms. with warm water, and exhausted by means of a displacement apparatus, constructed of a tube 2 feet long, 1 inch wide, and drawn out at the lower end, which is loosely stopped with cotton wool. Some substances may be introduced dry into this apparatus, and exhausted by warm or cold water. The extraction may likewise be facilitated by the pressure of a column of water, applied by fitting a narrow glass tube with a cork into the upper end.

In most cases, the extraction is completed in one or two days. When the operation is properly conducted, the quantity of liquid extract amounts to half a pound or a pound. It is then treated with gelatine solution so long as a precipitate is produced. A few drops of dilute hydrochloric acid facilitate the separation of the coagulum.

The quantity to be taken for an experiment of substances rich in tannin, such as galls, is about 0.5 or 1.0 grm. A simple calculation gives the percentage of tannin.

The author states that he has adopted this method in repeated examinations of tanning materials during the last ten years; he has found the results tolerably constant, and, notwithstanding its apparent imperfection, more trustworthy than any other yet known.

He estimates the relative value of several substances of this kind as follows: —

Pine bark contains from	5 to 7	per cent.	tannin.
Oak bark contains	9	"	"
Best oak bark contains	19 to 21	"	"
Galls nuts contain	30 to 33	"	"
Aleppo galls contain	60 to 66	"	"
Chinese galls contain	70	"	"

These data at least admit of comparison with each other, and indicate with tolerable certainty the respective value of these substances to the tanner. This method of valuation is indeed based upon the assumption that the same kind of tannin exists in all these substances. It is, however, extremely probable that this is not the case; but, at the same time, it may fairly be assumed, that if different kinds of tannin combined under similar conditions with different quantities of gelatine, they will also combine animal skins in the same relative proportions. If, therefore, this method does not indicate the absolute percentage of tannin, it still gives the percentage value of the substance examined; and it is precisely this which the tanner requires.

It is another question, whether gelatine solution precipitates all the substances of the tanning material which combine with the skin; and it therefore remains to be determined by experience whether such a method of valuation is sufficient for the purpose of the tanner.

COLORING MATTER OF FLOWERS.

This question has been studied by several chemists, and still is, beyond doubt, one of the most obscure subjects in vegetable chemistry. Botanists have long admitted that flowers owe their color to two coloring principles—a blue, called *cyanic*, and a yellow, called *xanthic*. For some time the blue color of blue flowers was attributed to presence of indigo; but Chevreul showed that this blue is always reddened by acids, which fact sets the indigo theory aside.

MM. Frémy and Cloez have isoluted the blue principle, and they call it *cyanine*. To obtain it, they treat with boiling alcohol the petals of the violet, or iris, until the flower is colorless and the liquid takes a fine blue tint. The tint disappears soon, but reappears on evaporating the alcohol in the air; on pouring water into the product of this evaporation, a resinous substance separates; the coloring matter remains in solution, and may be precipitated by acetate of lead; the precipitate is green; it is washed with a large amount of water, and treated with sulphuretted hydrogen, which removes the lead, and leaves the cyanine in solution. It is gently evaporated in a water-bath, absolute alcohol is added, and then the cyanine is precipitated in bluish flocks by ether. This coloring matter is uncrystallizable; acids turn it red, alkalies green; it combines with lime, baryta, &c.; sulphurous, phosphorus, and other acids, discolor it; it resumes its blue color through the presence of the oxygen of the air.

The coloring matter of roses, peonies, some dahlias, &c., is a modification of cyanine; the vegetable juices have an acid reaction, (which changes the blue cyanine to red;) while the juices of blue flowers are neutral. In the presence of alkalies, the rose color becomes, first blue, and then green.

The yellow coloring matter has no relation to cyanine. There are two different substances—one insoluble in water, *xanthine;* the other very soluble, *xantheine;* the former is analogous to the resins, and, along with cyanine, it produces in flowers an orange color, a scarlet, and a red. The xantheine combines easily with oxides; alkalies change it to brown of a very rich color and of considerable strength; but acids cause the brown color to disappear. These are the three principal coloring ingredients of flowers. M. Filhol, who has also studied this subject, confirms the results of MM. Frémy and Cloez. He has, however, found that these coloring matters may be disguised, or even destroyed, by mixture with the juices of white flowers.

M. Pepin, "Chef de Cultures" at the Jardin des Plantes, of Paris, has made some curious observations on the change of color which culture produces in flowers. He has found that cultivated annuals experience a change of tint more promptly than perennial plants, for each year they are renewed through the seeds. Such a change is, however, sometimes produced in biennials and perennials, and rarely ever in ligneous species.

The annual plants of Chili, Texas, and California, have a strong tendency to produce varieties with white flowers, especially when their flowers produce either of the primary colors,—red, yellow, or blue. The same is true of many other species introduced into France. The varieties with white color are first produced, and afterwards the variegated.

MUREXIDE AS A COLORING MATERIAL FOR WOOL.

The following article on an interesting and important subject is taken from the *Bulletin de la Société Industrielle de Mulhouse:* —

"The beautiful researches of Liebig and Wohler upon uric acid and its derivatives made us acquainted with a peculiar substance, to which they gave the name of alloxan. This body is obtained by adding very gradually 1 part of uric acid to 4 parts of nitric acid, of a specific gravity of from 1.45 to 1.5. The uric acid is dissolved with evolution of nitrogen and carbonic acid, accompanied by a considerable rise of temperature, which must be prevented as much as possible; on cooling, the mass becomes nearly solid, from the deposition of white granular crystals of alloxan. If these crystals be drained and dissolved in a very small quantity of water, and exposed to spontaneous evaporation in a moderately warm room, large, brilliant, colorless crystals, in the form of short right rhombic prisms, will be obtained. Alloxan is remarkable for the facility with which it undergoes changes when treated with different substances, and for the number of curious compounds thereby produced. Thus, if sulphuretted hydrogen gas be passed through a solution of it, sulphur is precipitated and a new body formed, to which the name of alloxantine has been given; or if its solution be slightly acidulated and a slip of zinc placed in it, the same body will be produced under the influence of the nascent hydrogen evolved during the dissolution of the zinc. Alloxantine, being sparingly soluble in cold water, readily separates in crystals, which may be obtained pure by solution in hot water: for, unlike alloxan, it is not decomposed by continued boiling. If 4 parts of alloxantine and 7 of alloxan be dissolved in 240 parts of boiling water, and 80 parts of carbonate of ammonia be added, a very peculiar body will be formed, which will crystallize on the liquor cooling. These crystals are of a beautiful garnet-red color by transmitted light, and have a beautiful iridescent green by reflected light. To this body the name murexide was given, from the murex, or shell-fish, from which it was supposed the Tyrian purple was formerly procured. Previous, however, to the experiments of Liebig and Wohler, Dr. Prout had described the same substance under the name of purpurate of ammonia, but obtained in a somewhat different way. So readily is this body formed, that a solution of alloxan will stain the skin purple in consequence of its production. This fact led its second discoverers to imagine that, like the Tyrian purple, it might be employed as a dye-stuff. The difficulty, however, of obtaining it, and of fixing it upon the fabric when formed, prevented for that time the idea from proving fertile.

Some time since, however, Dr. Sacc turned his attention to the subject, and led by the fact above mentioned, that a solution of alloxan stained the skin, came to the conclusion, that, by impregnating a piece of woollen cloth with that substance, he might be able to produce the murexide directly in the tissue. He tried the experiment, and succeeded in dyeing a piece of cloth of an amaranthus tint, far more beautiful than that produced by cochineal. He communicated the results of his first experiments, still incomplete, to M. Albert Schlumberger, who has succeeded, by modifying and completing the experiments of Dr. Sacc, in rendering the process, merely indicated by the latter, perfectly practicable.

His process is simple enough. He prepares a solution of alloxan, formed of 30 grms. of alloxan to each litre of water, and soaks the tissue to be dyed in it, the excess of liquid being then squeezed out in the ordinary way, or by pressure between rollers. The cloth is then dried at a gentle temperature, and after an ageing of twenty-four hours the color is brought out by passing the cloth over a roller heated to 212° F. For this purpose the drying machines composed of several drums would answer perfectly, the cloth being successively passed over each, the greatest care being taken to avoid folds; woollen yarn and wool should be put in a stove heated by steam. According as the heat is communicated to the cloth, a magnificent purple tint, far more beautiful than any thing hitherto produced by the ammoniacal preparation of cochineal, or by red dye-woods, makes its appearance as if by magic. The intensity varies according to the strength of the solution of alloxan which has been employed. It is only necessary to wash the cloth in cold water to give to the shade its full brilliancy.

M. Sacc found that the finest and most vivid shades could only be communicated to the tissues mordanted with salts of peroxide of tin, and M. Schlumberger has confirmed this observation. Cloth not mordanted did not give very satisfactory results, even after a prolonged exposure to warm and damp air. He obtained the most satisfactory results by soaking the cloth in a solution composed of equal parts of perchloride of tin and oxalic acid, of a specific gravity of 1.006. In this solution, at a temperature of about 100° F., the cloth is to be allowed to remain for an hour, then rinsed and dried, and is then fit to be treated with alloxan. If stronger solutions of the mordant be employed, there is a considerable loss of coloring material and a deterioration of the shade. This may be attributed to the presence of too great an excess of stannic acid, which from its opacity may mask the murexide, or by its acid reaction may decompose it. This is especially the case if chloride of tin be employed instead of stannate of soda. Experience has shown that fabrics freshly mordanted give better results that those which have been mordanted for some time; the depreciation in purity and brilliancy of tint in the latter may even amount to 20 or 30 per cent.

Murexide, as we have already remarked, being produced by the action of heat and ammonia, it occurred to M. Daniel Dollfus, and the other

members of the committee for the chemical arts appointed by the Société Industrielle of Mulhouse, to report upon the memoirs of M. Schlumberger, to try the effect of exposing a piece of cloth, treated with alloxan, to the vapors of ammonia. The result confirmed their anticipations; for the color was immediately produced without the necessity of ageing the cloth after its impregnation with the alloxan. There can, therefore, be no doubt that the best results will be obtained in future by the employment of ammoniacal vapors; for, besides the saving of time, there will also be a saving of alloxan. This substance is very liable to decompose, especially in the presence of even minute traces of reducing agents, such as protochloride of tin or sulphurous acid; traces of the latter substance always remain in the cloth after the operation of bleaching, no matter how well washed it may be, and would be quite sufficient to prevent the formation of the murexide.

As yet, all the attempts that have been made to communicate the murexide-purple to cotton or silk have failed, that substance having an affinity apparently only for wool, to which it gives a permanent and durable dye. Sunlight, so destructive to other purples, appears to have but little action upon that of the murexide; a piece of cloth dyed of a rose color had its tint scarcely altered by exposure to the full action of the strongest sunshine during two days, and the color was only fully discharged by an exposure of more than two months. Boiling water and steam completely destroy the color produced upon cloth mordanted with salts of tin; the decoloration commences in boiling water at a temperature of about 158° F., and augments with the increase of temperature. This destruction of the dye is caused by the action of the mordant; for cloth dyed without the use of mordant not only supports to a certain extent the action of boiling water, but even acquires a more uniform, and perhaps a more beautiful and deeper, tint than that given by prepared woollen fabrics. Further experience may show that hot water and the application of ammonia alone may be advantageously substituted for the mordanting and the passage over heated cylinders.

Cold alcohol or ether have no action on murexide purple; the former liquid destroys it at boiling temperature, without being colored purple as is water. Alkalies, especially in a caustic state, are very destructive to it; if a piece of cloth dyed with murexide be dipped into a solution of caustic soda, it assumes a violet-blue color, and is then decolorized. Soap, acting as a weak alkali, after a time alters it. Chlorine has no immediate action upon it, at least not in weak solut ons. Acetic and oxalic acids are not sufficiently energetic to immediately discharge the color. Hydrochloric, nitric, and sulphuric acids act as decolorizers; nevertheless the latter acts less quickly than the first two; and what is singular, the color almost destroyed by sulphuric acid reassumes a rose-violet by immersing the tissue in ammonia.

Bichromate of potash, chlorate of potash, acetate of lead, acetate of alumina are without action upon murexide. This is not the case, however, with reducing compounds, such as protochloride of tin,

sulphuret of ammonium, protosulphate of iron, which destroy the rose tint very rapidly; the protochloride of tin produces a blue tint before it decolorizes it. The reduction of the murexide gives birth to a new substance, which, in its turn, may reproduce that substance by a properly conducted oxidization.

From these reactions it is evident that the rose, amaranthus, and purple shades produced with the murexide, and which exceed those produced by all other means in richness and brilliancy of tints, have also the advantage of being the most solid and durable, an advantage which will no doubt be soon appreciated.

We have now to speak of the sources from whence the supply of uric acid may be obtained, should the employment of murexide become general. At present the price of that substance, which has never hitherto become an article of commerce, would be so high that the murexide-purple would be far more expensive than that produced with cochineal; but if we recollect that, independent of the excrements of serpents, from which hitherto uric acid has been made, those of pigeons, and especially of all carnivorous birds, silkworms, &c., and above all Peruvian guano, which may be obtained in immense quantities, are very rich in uric acid, and it may be produced from them at a very moderate price as soon as it becomes an article of commerce. No doubt, if necessary, fowls might be so fed as to produce it in much larger quantities than they do naturally.

Connected with this part of the subject, we may mention that, in the making of the alloxan from the uric acid, a considerable quantity of the former remains in the acid mother-liquid, from which the crystals of alloxan separate. This portion could not be used to impregnate tissues, in consequence of the nitric acid present, and would cause a considerable loss of material, and a considerable enhancement of the cost of the dye, unless it could be utilized. If a piece of zinc be introduced into the acid mother-liquid, alloxantine will be formed, which may be recovered by evaporating the liquid and allowing it to separate out. This substance, as we have before remarked, will also produce the purple color, and a mixture of it with alloxan will afford the best conditions for its production.

M. Schlumberger has indulged some curious speculations relative to the existence of this coloring matter ready formed in nature, which it may be interesting to notice. M. Sacc has found that poultry, and especially birds with very brilliant plumage, such as the different paroquets, do not produce sensible traces of uric acid during their period of moulting, whilst the quantity is very large when their feathers are fully developed. The question naturally suggests itself, What becomes of the uric acid in the former case? May it not be transformed by some as yet unknown metamorphosis in the animal body into a substance like alloxan, capable of coloring the feathers? Murexide, as we have observed, is green by reflected light; a substance, then, which gives violet (red and blue) and green (yellow and blue) can undoubtedly produce all shades of colors, which are made up of those three colors. How curious if it should hereafter be

found that murexide was indeed the source of all the varied hues of birds' plumage! Still further, it is chiefly those animals which have but one means of exit for their excrements, and who produce large quantities of uric acid, that exhibit a display of coloring. Thus, for example, we have the skin of the serpent and lizard, the scales of fish, the wings of butterflies, often colored in the most gorgeous manner; whilst the skins of the mammalia are dull, and without the iridescence and metallic lustre which are so characteristic of the coloring of some of the classes of animals mentioned. These are, however, mere speculations, but they nevertheless lead to a very unexpected supposition. The ancients were acquainted with a process for dyeing wool of a fine purple, which has been lost to our days, or at least is only practised in the East. Tradition, however, tells us that this beautiful purple tint was produced by pounding a quantity of small shell-fish, and adding to the mass either a quantity of urine in the state of putrefaction, or water in which some of the same shell-fish has been allowed to putrefy. The cloth soaked in the liquid produced by these mixtures only developed the beautiful purple color, after long exposure to the air, and probably to heat. This mode of producing the color so strikingly resembles that by which the new color of murexide is produced, that one is tempted to believe that the Tyrian purple was produced by that substance, and that, many centuries before the beautiful discovery of Liebig and Wohler, murexide was formed by the action of ammonia in the putrid matter employed upon substances derived from the uric acid which must exist in the intestines of the shell-fish pounded up.

ON THE ACTION OF CITRIC, TARTARIC AND OXALIC ACIDS ON COTTON AND FLAX FIBRES UNDER THE INFLUENCE OF DRY HEAT AND PRESSURE OF STEAM.

Mr. Calvert has observed that when two to four parts of these acids are dissolved in 100 parts of water, and linen or cotton dipped into the solution obtained, and afterwards dried in the air, they, on exposure to certain temperatures, completely destroy the tenacity of the fibre. This action of organic acids is interesting when it is known that it takes place even at the low temperature of 180°, 212° and 260° F. He also found that cotton and flax fibres, when prepared as above and then submitted to the influcnce of steam of three lbs. pressure, were destroyed.

ON THE DISTRIBUTION OF IODINE IN THE MINERAL, VEGETABLE, AND ANIMAL KINGDOMS.

Dr. McAdam, in a communication to the British Association, stated that an experiment where 100,000 cubic feet of air were analyzed, and one recently undertaken by him, where 50 gallons of rain water were examined, having failed to yield a trace of iodine, he was inclined to think that other and more carefully conducted experiments were required before the

statement advanced by Chatin—that an appreciable amount of iodine was present in the atmosphere—could be admitted. The author had found a trace of iodine in 100 gallons of the water used for domestic purposes in Edinburgh, as also in about 60 land plants, some of which were edible,—such as potatoes, wheat, barley, oats, beans, peas, pears, apples, and gooseberries. The presence of iodine in the food of animals necessitated its introduction into the system of the animal, and, for a time at least, its retention there. The author accordingly found iodine in the cat, the dog, the pig, the cow, the horse, and man. In every instance but one, muscle was the only part of the animal frame employed. In the horse, however, the lungs, liver, heart, spleen, and kidneys, as well as the muscle, were examined, and each organ yielded iodine. The milk and blood of the cow and common eggs gave a like affirmative result. The passage of iodine from the animal system had also occupied the attention of the author. By wearing a starched gauze respirator for six nights, (about 50 hours,) it was apparent, from no blue or rose tint being imparted to the gauze, that no iodine had left the system by that road; whilst other experiments showed that the iodine compounds accompanied the other saline matters in their passage from the animal. No direct experiments had been made on soils; but considering that iodine is uniformly a constituent of limestone rocks, and that these are always present in and applied to soils, the author believed that the latter must, to a greater or less extent, contain iodine.

APPLICATION OF ESSENCE OF COAL AS A SUBSTITUTE FOR OIL OF TURPENTINE.

M. Pelouze, the son of the distinguished chemist of that name, proposes to use an oily fluid consisting of a mixture of carbo-hydrogens, especially of benzoine, &c., as a substitute for oil of turpentine in painting. He obtains this fluid, which boils from 100 to 168° centigrade, by the distillation of cannel coal, by means of sur-heated steam. This liquid is colorless, very fluid, and completely volatile, leaving no stain upon paper, and is not altered by exposure to the light. It has a penetrating smell, which reminds one of common coal gas; but this entirely disappears when it has evaporated. A number of comparative experiments have been made, with the object of comparing it with oil of turpentine, by a committee of the Société d'Encouragement of Paris, all of which have resulted in showing that walls, woodwork, &c., painted with the essence of coal, dried far more rapidly, and the smell disappeared sooner, then where essence of turpentine was employed. For example, in one case where the coal essence and oil of turpentine were respectively mixed with three times their volume of oil, and employed under exactly similar circumstances, the smell of the essence of coal was completely dissipated at the end of three days, while that part painted with the turpentine mixture had still a strong smell, and was not completely dry. The introduction of

such an oil would be of great importance, not only in a commercial point of view, but in a hygienic one also.—*Bulletin de la Société d'Encouragement.*

MELTING POINT AND TRANSFORMATION OF SULPHUR.

Sir B. C. Brodie, F. R. S., read a paper on sulphur, at a recent meeting of the London Royal Society, in the course of which he remarked that, in the various treatises of chemistry, great discrepancies exist respecting the melting point of sulphur, so much so that he was led to make several experiments, with the view of discovering, if possible, the true laws which regulate the transformation of sulphur and its liquidation. The melting point of sulphur varies according to its allotropic condition. This condition is readily altered by heat, and invariably, without peculiar precautions, by melting. Hence the temperature at which sulphur melts is different from that at which it will solidify, or at which, having been melted, it will melt again. The melting point of the octohedral sulphur is 114.5°. But from the facility with which this sulphur, when heated even below its melting point, passes into the sulphur of the oblique system, this fact may readily be overlooked. When this sulphur, even in the shape of fine powder, is heated for the shortest time between 100° and 114.5°, this change cannot be avoided. For the transformation of large crystals a longer time is required. At a certain point the crystals become opaque, and are often broken in pieces at the moment of the change. When sulphur has been converted by heating a sufficient length of time, it acquires a fixed melting point of 120°. This is the melting point of the oblique prismatic sulphur. If sulphur thus converted be carefully melted so as to raise the temperature as little as possible above the melting point, no sensible difference will be observed between the point of melting and that of solidification. To obtain this fixed melting point of 120°, care must be taken that the transformation of the sulphur has been thoroughly effected. If this be not done, it may melt at any point between 114.5° and 120°. If, however, the temperature of the melted sulphur be raised above its melting point of 120°, the point of solidification will be altered, and will lie even below the first melting point of 114.5°. The sulphur which is insoluble is bisulphide of carbon. This is prepared by extracting the hardened viscid sulphur with that re-agent, which has a melting point considerably above 120°, but which the author has not been able to determine with precision. It is stated in chemical treatises that the opacity, which on solidification comes over the melted sulphur, is due to the transformation of the oblique prismatic into the octohedral sulphur, and the consequent disruption of the crystal. To this cause is also attributed the evolution of heat, which has been observed in solid sulphur immediately after cooling. There are, however, no sufficient grounds for this view, and some of the observations are decidedly adverse to it. On extracting melted sulphur which had become opaque with the

bisulphide of carbon, traces of insoluble matter were constantly found, even when the greatest precaution had been taken to avoid elevation of temperature; and this opacity appears to be due to the hardening of the viscid sulphur, and the consequent deposition of opaque matters in the pores of the crystals, which is quite sufficient to account for it. It remains, therefore, to ascertain the cause of the evolution of the heat; and on this point the author suggests that, when the sulphur is tempered, the change takes place very slowly, and the heat evolved is not perceived. This view is confirmed by a fact that the viscid sulphur possesses another solid form. Sir B. C. B. has found, moreover, that when sulphur melted at a high temperature is suddenly exposed to intense cold, such as the cold of solid carbonic acid and ether, the sulphur formed is not viscid, but solid, hard, and perfectly transparent. When the temperature is allowed to rise to that of the air, this sulphur becomes soft and elastic.

OZONE.

M. Meidinyer, at a recent meeting of the London Chemical Society, described the results of some investigations which he undertook, with the view of ascertaining the causes of irregularity in the formation of the decomposition products of water in voltametric operations. He found that, whenever ozone is produced in considerable quantity, the volume of the evolved oxygen is much less than that which would correspond with the hydrogen given off at the same time. The strength of the current, the temperature of the decomposing liquid, the strength of the acid, and the size of the electrodes, were found to exert a marked influence on the results; but the deficiency in the evolved oxygen, which was sometimes very considerable, could not be wholly accounted for by the quantity of ozone present; and the author considers that the large quantity of oxygen which sometimes disappears during the electrolysis is retained in the liquid in the form of peroxide of hydrogen.

ARTIFICIAL PRODUCTION OF OIL OF CINNAMON.

Strecker showed some years since that styrone is the alcohol of cinnamic acid. He now finds that it may be readily transformed into its aldehyde by the action of air and platinum black. This aldehyde is pure oil of cinnamon.

At a late sitting of the Paris Academy of Sciences, M. Castets, manufacturing chemist at Puteauz, presented a sealed paper containing a description of the discovery which he had made of the artificial production of quinine.

INFLUENCE OF PRESSURE UPON THE FORMATION OF CHEMICAL COMPOUNDS.

Hydrate of chlorine, which is immediately decomposed at ordinary temperatures, and at the pressure of the atmosphere, remains for the most part undecomposed, even at a summer heat, when enclosed in hermetrically-sealed tubes, under the pressure of the chlorine which is set free from a portion of it which undergoes decomposition. In such a tube, when plunged into water of a temperature of 86°–104° Fah., the hydrate of chlorine is decompósed, but becomes partially restored on its return to the ordinary temperatures.

This decomposition is not prevented by the exclusion of the air under the pressure of chlorine gas of the tension of the atmosphere; under these circumstances, the decomposition takes place as usual at any temperature above 32° Fah.

A tube in which hydrate of chlorine was hermetrically sealed was exposed to the sun for a whole summer's day. It became fluid, but did not indicate decomposition of the water by the setting free of oxygen.

The author had already observed that, during the preparation of liquid sulphuretted hydrogen from sulphuret of hydrogen in hermetrically-sealed tubes, colorless crystals are sometimes formed, which immediately disappear on the tube being opened.

In two tubes, in which sulphur, but no liquid sulphuretted hydrogen, had separated, these crystals were found in large quantity; they did not, however, make their appearance in a third tube, in which the persulphuret of hydrogen was enclosed together with concentrated muriatic acid. Hence the author concludes, that the crystalline compound, which is no doubt a hydrate of sulphuretted hydrogen, must be produced when a small quantity of water is enclosed with hydrate free from acid; the water then combines with the sulphuretted hydrogen under the pressure of the condensing sulphuretted hydrogen, (17 atmospheres.) Under this pressure it is permanent at ordinary temperatures. If the tube be heated in water to 86° Fah., the compound dissolves, and rapidly becomes fluid, returning to a solid state again on being cooled to the ordinary temperature.—*Prof. Wohler Ann. der Chem. und Pharm.*

GEOLOGY.

RECENT PROGRESS OF GEOLOGY.

The researches which M. Barrande has made upon the Silurian system of Bohemia have recently been published. They imbody the fruits of more than twenty years' labors; and his labors and results now place him in the foremost rank of living geologists and palæontologists. The number of fossils he has collected and described from the Silurian system is about 1200. M. Barrande distinguishes eight stages of strata, to which he assigns a Silurian age; four of them he regards as Lower Silurian, and four as Upper Silurian. Of his Lower Silurian stages the two lowermost are azoic, the distinctions between them being founded on mineral characters, the first being composed of crystalline rocks, and the second of clay-slates and conglomerates, similar to the fossiliferous Silurian above them, but wholly destitute of organic remains. These azoic stages pass into each other, and the upper section passes gradually into the fossiliferous beds above. The third stage of his Lower Silurian, and the first of his fossiliferous horizons, attains a thickness of 1200 feet, and contains no beds of limestone. The fauna of this section is very peculiar; it is composed almost wholly of trilobites and a few other fossils. These constitute a fauna upon which he lays great stress, and designates as *primordial.* All the species are peculiar to itself, and the genera are low and rudimentary, not typical and highly-developed forms.

In Wales, and some other Silurian districts, this primordial fauna has also been clearly made out. The rocks which contain it are those designated by Prof. Sedgwick as the Lingula beds.

The fourth and uppermost division of M. Barrande's Lower Silurians is composed of quartzose strata, with schistose alternations. Cephalopoda, Gasteropoda, Acephala, Brachiopoda, a few corals, starfish, crinoids, make up, with trilobites, the fauna of this group in Bohemia. Trilobites prevail above all other forms, and here attain their maximum development.

Of the four stages of the Upper Silurians in Bohemia, the three lower divisions are typically calcareous, and the culminant section schistose. The lowermost stage is astonishingly rich in fossils, containing between 500 and 600 species. The second stage presents a decreasing fauna, and

in the third fishes commence, and brachiapods have become rare. In the uppermost stage the community of species is reduced to the trilobites, and the entire fauna is poverty stricken. Traces of vegetables also indicate some considerable changes in the conditions of the sea-beds.

M. Barrande definitely settles the fact, that the trilobite undergoes metamorphoses in the course of its existence as an individual. He has demonstrated the fact in the case of sixteen genera and twenty-eight species. The degree of change is variable, and its intensity is comparable with the phenomena in existing Crustacea. Among other points, M. Barrande has made out the probable eggs of these animals. As to their mode of life, he is opposed to the opinion that they lived in shallow water along the coast, and distinctly pronounces against the supposition of their parasitic nature.

Prof. Forbes expresses it as his opinion, in regard to the extinction of species in geological time, that every year's research makes it more and more evident that it is simply the result of the influence of physical changes in specific arrears, and depends upon no law of inherent limitation of power to exist in time.

M. de Archiac and Haime are about to publish an extensive work on the fossil animals of the nummulitic rocks of India.

The enormous increase of palæontological observations may be measured by a comparison between the number of British fossils catalogued a few years since and the number at present recognized. The number of plants recorded in 1843 was 510; in 1853, 652 are cited. The increase is chiefly among the Mesozoic and Tertiary types. The Foramenifera, of which 82 were mentioned in the list of 1843, has increased to more than 168. Of Zoöphytes, the number has increased from 183 to 438; of Bryozoa, 117 new species have been added; of Echinodermata, 213; of Cirripedia, 21; Crustacea, about 150; Brachiopoda, 200 new species; of Monomyarian Bivalves, about 250; and of fossil insects, the number has also largely increased. This increase it must be remembered pertains only to the British Islands.

Says Prof. Forbes, in his address before the London Geological Society, "Every geologist, whose studies have been equally or nearly directed to the organic phenomena of the three great sections of time usually received, Palæozoic, Mesozoic and Tertiary, cannot fail to have been struck with the greater value of the difference between the first, or oldest section, and the two newer divisions, taken together, than between the first and middle terms, and between the latter and the last. The degree of organic difference between the Upper Mesozoic and the Lower Tertiary epochs is rather more, but only slightly more, than the degree of difference between the lower and upper sections of the great Mesozoic period. But the gap between Palæozoic and Mesozoic, although the link be not altogether broken, is vastly greater than at any other of the many gaps in the known series of formations. I am one of those who hold, *a priori*, that all gaps are local, and that there is a probability at some future time of our dis-

covering gradually, somewhere on the earth's crust, evidences of the missing links. All our experience and knowledge, theoretical and practical, warrant the affirmation, that at every known stage of geological time there were sea and land. Even those who believe in a primeval azoic period will hardly sanction the supposition that there has been any repetition of azoic epochs since the first life-bearing era commenced; and if so, and if there were always sea and land since the commencement of the first fossiliferous formation, we are warranted in assuming that both earth and water had their faunas and floras. All geological experience goes to show that wherever you have a perfect sequence of formations accumulating in the same medium, air or water, as the case may be, there is, if not a continuance of the same specific types, a graduated succession and interlacement of types and of the facies of life assemblages, even as on the present surface of the earth the faunas and floras of proximate provinces intermingle more or less specifically, or, if physical barriers prevent the diffusion of species, assume more or less one general facies. This passage, by aspect and type, of one stage in time into another, is but scantily indicated at present in the uppermost manifestations of the Palæozoic life and the lowermost of the Mesozoic. The missing links will sooner or later reward the diligence of the geological explorer."

ON THE FORMER PROBABLE EXISTENCE OF PALÆOZOIC GLACIERS.

At the British Association, a communication on the above subject was presented by Prof. A. C. Ramsay, F. R. S. The author commenced by stating that the theory, of the internal heat of this planet having within any of the known geological periods exercised any climatal influence, was gradually beginning to be discredited, and he proposed to show that glaciers and icebergs had existed in these latitudes during a part of the Permian epoch, and that also, in the secondary period, there were traces of the same actions in some of the beds of the Bunter Sandstone.

In the Permian rocks of the midland counties of England are thick beds of trapoid breccia, occupying a given geological horizon. They are about 100 and 200 feet thick, according to locality, and consist of pieces of greenstone, felstone porphyry, felstone, felspathic ash, ribbon slate, quartz rock, purple and green sandstone and slate, black slate, Silurian limestone, &c. These are not derived from the rocks immediately underlying, but for the most part can be identified with rocks of the Longmynd, and the Lower Silurian slates and igneous rocks, &c., immediately west of, and accociated with, the Stiper stones. They are enclosed in a hardened paste of red marl, analogous in some respects to the bould-clay of the Pleistocene epochs. Very few of the stones are well rounded by the action of water. They are mostly angular or sub-angular, and have those peculiarly flattened surfaces common to fragments found in Moraines. They are frequently well polished, and occasionally scratched. They are of all sizes, up to two feet nine inches in diameter. Had they ever formed sea-

beaches, they would probably have been rounded by the action of the waves; and if great marine floods ever existed, driving before them such great masses of *debris*, the same rounding action would have resulted. Such large blocks of rock are not moved along ordinary sea-bottoms by tidal or other actions; and, considering their size, angularity, polish, occasional scratchings, and the matrix that encloses them, the author believes that they were deposited from icebergs, derived from glaciers that originated in the ancient land of the Longmynds, and overlying Lower Silurian strata, west of the Stiper stones. These rocks were once covered unconformably by more than 3000 feet of Upper Silurian rock, and probably by a large part of the old Red Sandstone besides. These had, therefore, been removed by denudation before the deposition of the Permian strata. A great fault of more than 3000 feet runs from north-east to south-west, immediately east of the Longmynds. It is a downthrow on the west of later date than the New Red Sandstone, and the range of the Longmynds was, therefore, from 3000 to 4000 feet higher at the Permian period than now with reference to the existing levels of these formations. Traces of the same glacial action occur in the Bunter Sandstone, in a portion of the pebble-beds that lie between the lower and upper variegated sandstone, and also at the base of the white sandstones that underlie the new red marl in the neighborhood of the Abberley Hills.

In addition to the above, Prof. Ramsay presented another paper, the object of which was to prove that the ice of the greater glaciers of North Wales was about 1300 feet thick; that the valleys of Llanberis, Nant Francon, &c., were, in fact, filled with ice, at least of that thickness. This was inferred by the height on the walls of the valleys at which polished surfaces, and parallel grooves and scratches, were plentifully found following the main direction of the valleys, without reference to the minor lateral valleys. During the subsequent depression of the country to a depth of 2300 feet the cold still continued, and glaciers on a smaller scale passed out to sea and deposited what may be called marine moraines. Farther out at sea, on Mod Tryfan, marine deposits with shells were formed, either contemporaneously with these marine moraines, or during subsequent oscillations of level by the rearrangement of the moraine matter.

After the re-emergence of the land, the drift was cleared out of the greater valleys by a second set of glaciers. These gradually decreased in size, evidence of which may be found in the moraines that occur in the valleys at different levels. In Cwm Glas, in the pass of Llanberis, there are several of these moraines left by a retiring glacier, which finally disappeared in the highest recesses of the valley immediately north of the ridge of Cribgoch.

ON THE DEPTH OF THE PRIMEVAL SEAS.

Prof. Forbes, in a communication to the Royal Society, states that, when engaged in the investigation of the bathymetrical distribution of

existing mollusks, the author found that not only the color of their shells ceases to be strongly marked at considerable depths, but also that well-defined patterns were, with very few and slight exceptions, presented only by testacea inhabiting the littoral, circumlittoral and median zones. In the Mediterranean, only one in eighteen of the shells taken from below 100 fathoms exhibited any markings of color, and even the few that did so were questionable inhabitants of those depths. Between 35 and 55 fathoms, the proportion of marked to plain shells was rather less than one in three, and between the margin and two fathoms the striped or mottled species exceeded one-half of the total number. In our own seas, the author observes that testacea taken from below 100 fathoms, even when they were individuals of species vividly striped or banded in shallower zones, are quite white or colorless. Between 60 and 80 fathoms, striping and banding are rarely presented by our shells, especially in the northern provinces; and from 50 fathoms, shallow bands, colors and patterns are well marked. The relation of these arrangements of color to the degrees of light penetrating the different zones of depth is a subject well worthy of minute inquiry, and has not been fully investigated by natural philosophers.—*Proceedings of the Royal Society.*

THE GULF STREAM.

At the American Association, Prof. Bache read a paper on the distribution of temperature in and near the Gulf Stream of the coast of the United States.

On the seaward line off Charleston, from the shore to sixty miles out, the depth increases gradually till it acquires a depth of one hundred fathoms. But it soon deepens with great rapidity, as if on the side of a mountain, until at about eighty miles out the ocean-bottom is more than six hundred and fifty fathoms from the surface. This continues forward less than ten miles, when the depth as suddenly decreases to not more than three hundred and fifty fathoms, which so goes on only a few miles, when it again deepens to about five hundred fathoms, with subsequent fluctuations. There is, therefore, a submerged mountain-peak or ridge between these points of a truly remarkable character. The differences in the temperature vary almost precisely according to the change of contour of the bottom, showing that the temperature at great depths is much modified by the propinquity of the ocean's bed. It appears that the Gulf Stream, while certainly not superficial, does not run to the bottom; for off Cape Florida, at twelve hundred fathoms, the water in summer is of a temperature of 38° Fahrenheit — a degree below the average winter temperature much farther north.

Lieut. Maury followed Prof. Bache. He showed that the stream varies its course according to the season, having a more southerly sweep in winter. The stream is more rapid of Cape Hatteras than Cape Canaveral, and never deposits the seaweed, with which it is so plentifully beset, on

the western side. This was accounted for by supposing that the stream stands above the general level of the ocean, with its highest point in the centre or axis of the stream, and sloping off like the roof of a house each way. This stream is what modifies so agreeably the climate of Western Europe, and at the same time causes its fogs. Storms that arise on the coast of Africa, trailing westward, fall into its influence, and sweep around its circuit. In this stream the "San Francisco" was on the 26th of December, and it was along its eastwardly current that the ship drifted. The Gulf Stream is sensibly affected by the discharge of the waters in winter from the Chesapeake, Delaware and Hudson.

ON THE CAUSE OF THE PRIMITIVE INCANDESCENT CONDITION OF THE EARTH AND OTHER PLANETS.

The following paper on the above subject was read before the Royal Astronomical Society by James Nasmyth, Esq.:—

No fact has been more clearly revealed by geology than that of the former igneous or molten condition of our globe, and that its present condition is the result of a succession of changes consequent on the escape, or passage into space, of the greater portion of that primitive heat, the residue of which occasionally manifests itself in the molten outbursts which the now comparatively few active volcanoes vomit forth, and which we may consider to be the expiring vestiges of the once universal molten state of our globe. As I have not met with any attempt to trace to its source, or assign a cause of, this primitive molten condition of the earth, in the most earnest but humble spirit of philosophic suggestion and inquiry I desire to offer in this brief form the result of some thoughts on this interesting subject, in the hope that the following remarks may chance to suggest further investigation, and so yield results more worthy of so grand a subject. In order to state in the most simple form *the principle* upon which I base my speculations on the source of the primitive heat of our globe, I would refer to the well-known principle in the laws of matter—namely, that when matter, whether in the solid, fluid, or gaseous condition, is, by some external or internal force or agency, caused to occupy less space, heat is evolved. Applying this general principle to what there is such strong reason to suppose was the first condition of that matter which was destined to form our globe, and carrying our ideas back to the first moments of its physical history at which we may suppose it to have been summoned forth into existence as a nebulous mass, either distinct and separate, or as a separated portion from a greater nebulous mass, and granting that the law of gravitation was coexistent, it appears to me that, if we assume these conditions, the inevitable result of the action of the law of gravitation, operating on the particles of matter composing a nebulous mass, would be a progressive decrease, or collapse, of the original volume of such nebulous mass, and that the result of this decrease of volume by the collapse action of gravitation would be accompanied by rise of temperature, more

especially at the centre of gravity of the mass, where a nucleus would be formed, and upon whose surface myriads of particles would come crowding inwards and attach themselves; while, by the general collapse of the entire mass of the nebulous body, resulting, as before said, from the action of gravitation of its particles towards its centre of gravity, that heat which was latent in the original or primitive expanded volume of the nebulous mass would come forth and manifest itself as active heat, most intense nearest to where the focus of action lay, where it would result in a glow of fervent intensity, of which we can form no adequate conception. In this manner I conceive the temperature of the nucleus would continue to increase, while the dimensions or volume of the nebulous mass went on diminishing, through ages of time, until the temperature of the nucleus reached such a pitch of intensity as to begin to check the accelerating influx of particles by the dispersive influence of the intense heat of the nucleus. Then would ensue an era of retardation in the progressive accumulation of matter upon the nucleus; and its after history would most probably be governed by the combined action of gravitative accumulation and those changes which would result from the continual escape of the heat of the remaining nebulous envelope, and so render the matter of which it was composed more subject to the attractive influence of the globe now existing within it. I conceive that countless ages might thus elapse, through the mutual action of the agencies I have referred to, ere such a globe had commenced the earliest stages of its geological history, which would date from that period when all further accession of temperature was at an end, and the nucleus (now a planet) began to part with its primitive heat by its radiation into space. Thus I have endeavored to assign as the cause of the primitive incandescent temperature of planetary masses the action of gravitation upon the nebulous matter of which they are conceived to have been formed: the action of gravitation overtaking in its collapsing influence that gradual decrease of volume which might otherwise have occurred through simple contraction, and so expressing the heat latent in the nebulous volume, and causing it to come forth as sensible heat in most active condition, and so manifest itself in a state of intense incandescence in the nucleus or planetary mass.

ON THE THICKNESS OF THE SILURIAN ROCKS OF GREAT BRITAIN.

More than twenty years have passed since Sir Roderick Murchison commenced those brilliant researches among the most ancient sedimentary rocks that have secured for him a lasting place among eminent geologists. Before he investigated, analyzed and defined the Silurian system of formations, the knowledge possessed by naturalists of the earliest phenomenon of life in our planet was scanty in the extreme — indeed, rather deserving the name of utter ignorance. Under the vague term of "graywacke" were included rocks of different ages, structures, organic characters, and vast thickness. It is difficult, for those whose scientific careers have com-

menced since the publication of Sir Roderick's first great work, to understand now the peculiar condition of palæozoic geology at the time he started upon his scientific mission. All seems so orderly, clear, and self-evident — Silurian, Devonian, Carboniferous, and Permian, being words that convey definite and precise meanings to the youngest student of a school of mines or geological class-room—that we cannot picture to ourselves the darkness and confusion out of which the definitions were eliminated.

It is the proud boast of British geologists that the foundations of many of the great sections of their science, and the establishment of most of the realms in time enrolled in the scale of formations constituting the crust of the earth, were originated within their native archipelago. The very provincial jargon of working miners and quarrymen, and the local appellations given to rock and soil by our peasants, have become scientific terms, established in the language of philosophical treatises all over the world. When a name was wanting, and could not be taken from these illiterate sources, it was struck in a British mint; and among all the stamps that mark the world's rocks as British claims, one of the most widely current and permanently graven is that of "Silurian." An old British people, a tribe of borderers, who, under the leadership of the famous Caractacus, fought the Romans, has given its name to far-spreading territories; and could the old Silures be summoned once more to life, they would have some difficulty in finding the true Siluria, so many offsets of their ancient kingdom are now dotted over the map of the world. Since the system named after this province was first announced, Silurian strata have been detected far and wide over the face of the earth. In Germany, France, Scandinavia, Russia, Spain, and the Mediterranean, a Silurian basis has been found on which the other fossiliferous rocks successively repose. In Siberia, China, and India, Silurian strata have either been already demonstrated, or the next thing to it. In both North and South Africa the rocks that come next in order have already been detected. In Australia well-marked Silurian types are proved to exist. In North America is one of the grandest developments of the Silurian system in the world, that displays both physical and palæontological features in wonderful variety and profusion. In South America there are indications of strata of similar age.

From a recent work of Sir R. Murchison, we make the following extract relative to the vertical dimensions of the Silurian rocks of the British Isles, which will in a measure serve to show the non-geological reader the immensity of the formations under discussion, and the vast lapses of time that must have rolled on during their deposition :—

"We have as yet no means of accurately estimating the thickness of the older deposits of Scotland and Ireland; but I find, on consulting with Professor Nicol, that the Scottish section given can hardly represent less than 50,000 feet; although we have no indication that the bottom of the sedimentary series is reached, nor have we any thing like a completion of the Upper Silurian rocks.

"In the mean time, reverting to the region of Wales and the adjacent English counties, we can appeal to the admeasurements of the Government surveyors. In Shropshire, the unfossiliferous bottom rocks (the Cambrian of the Survey) are said to have the thickness of 26,000 feet, or about three times that of the same strata in North Wales; whilst my original Lower Silurian strata of Shropshire to the west exhibit a width of 14,000. On the other hand, in the region between the Menai Straits and the Berwyn Mountains, where the bottom rocks are so much less copious than in Shropshire, the fosiliferous Lower Silurian, from the base of the Lingula flags to the top of the Llandeilo formation, (including the stratified igneous rocks,) swell out to about 19,000 feet, and the Caradoc sandstone has a thickness of from 4,000 to 5,000 feet. Taking the greatest dimensions, we are, therefore, presented with the prodigious measurement of about 50,000 feet of sedimentary strata, in the lower half of which no fossils have been found, the upper part bearing a group of fossils. Although of such vast volume in parts of the region described, it must be observed that the Lower Silurian rocks of other tracts, though precisely of the same age, as proved by their embedded organic remains, are often comparatively of very small dimensions.

"Though more replete with fossils than the inferior group, the Upper Silurian rocks attain nowhere a greater thickness than from 5,000 to 6,000 feet, the Ludlow rocks being for the most part more developed than the Wenlock formation. In this way the whole of the fossiliferous Silurians of England and Wales, measured from the Lingula beds to the Ludlow rocks inclusive, have the enormous maximum dimensions of about 30,000 feet; and if we add the conformable underlying sedimentary masses of pretty similar mineral aspect, but in which no fossils have been found, we have before us a pile of subaqueous deposits reaching to the stupendous thickness of 56,000 feet, or upwards of ten miles!"

In reference to the supposition that the Lower Silurian rocks present the earliest zone of animal life, Sir R. Murchison says:—

"*This is the important fact to which attention is first directed;* for in such instances the geologist appeals to the book of Nature, where its leaves have undergone no great alteration. He sees before him an enormous pile or series of early subaqeous sediment originally composed of mud, sand, or pebbles, the successive bottoms of a former sea, all of which have been derived from preëxisting rocks; and in these lower beds, even where they are little altered, he can detect no remains of former creatures. But lying upon them, and therefore evolved after, other strata succeed, in which some few relics of a primeval ocean are discernible, and these again are every where succeeded by newer deposits in which many fossils occur. In this way evidences have been fairly obtained to show that the sediments which underlie the strata containing the lowest fossil remains constitute, in all countries which have been examined, the natural base or bottom rocks of the deposits termed Silurian."

ON THE FORMER EXISTENCE OF A GREAT SEA IN THE INTERIOR OF RUSSIA.

There is perhaps no feature of more commanding interest, in its bearing on the physical outlines of the earth at a period which approaches near to our own era, than the fact, which geological researches have established, that there has existed a vast interior sea, which covered all the area between Constantinople on the west and Turkestan on the east, or a length of nearly 2,000 miles, whilst it ranged irregularly from north to south over a space broader than the present Caspian Sea is long, or of about 1,000 miles. Of this great submerged area, the Seas of Azof, the Caspian, and the Aral, are now clearly the chief detached remnants. For the very same species of mollusca which are now living in these seas are found in a fossil state in limestones forming cliffs on their shores, or on those of the Black Sea, or in masses of intermediate land, which are simply elevated bottoms of a once continuous vast internal sea, the whole of whose inhabitants were as distinct from those of the then ocean as are the present inhabitants of these detached Caspians from those of the present Mediterranean and ocean.—*Sir R. I. Murchison's Address to the Royal Geog. Soc.*

ON THE STRUCTURE OF LUNAR VOLCANIC CRATERS.

Mr. James Nasmyth, at the British Association, presented a communication on the above subject, which was illustrated by a model of the lunar volcano Copernicus and a diagram of Simpelius; each of which consists of a plateau, with a small central cone, surrounded by a ring-shaped elevation, exhibiting concentric ridges or terraces. The circular elevations were supposed to have been formed by the accumulation of materials erupted with great energy to various distances, according to the intensity of the force; giving rise to concentric ridges, or *terraces of deposition*, which are often nearly entire circles, one within the other. Besides these there are other terraces, forming only segments of circles, within the principal rings, which were attributed to the agency of landslips; these in most instances correspond to notches in the edge of the crater, from which they have slipped, and their debris has rolled onward over the plateau, towards the centre. The central cone was attributed to the last expiring efforts of the eruptive action.

Prof. Phillips observed that, although there might be no sign of the existence of water on the present surface of the moon, he thought there were many indications of former aqueous action. There were elevations like the *escars* of Sweden and Ireland, and small gullies converging into larger, like the channels of mountain streams. He also called attention to the narrow, dark lines, many miles in length, occasioned by shadows which change with the direction of the sunlight, showing that the level is higher on one side than the other, as in cases of *fault*.

Mr. Hopkins inquired into the evidence respecting the existence of an atmosphere, or of water, on the moon. If any atmosphere existed, it must be very rare in comparison with the terrestrial atmosphere, and inappreciable to the kind of observations by which it had been tested; yet the absence of any refraction of the light of stars during occultation was a very refined test. No equal means existed of ascertaining the presence of water on the moon; and if it did not now exist, the opinion of its former existence rested on very uncertain evidence. The large size of the lunar craters compared with any on the earth was accounted for if they were produced by the expansion of a fluid mass; for there was no reason why such a force should be materially less in the moon than the earth, whilst gravitation was much less. The result would be, not only a much greater elevation, but less tendency to fall. He considered the annular craters were the remains of dome-shaped elevations, of which the central part had fallen in. The lunar craters were more numerous in proportion to the terrestrial; but there might have been many more on the earth which have been washed away.

Mr. James Smith remarked that the perfection of the lunar volcanoes might be due to atmospheric conditions, and referred to the great circular crater of the Sandwich Islands as being terraced like Copernicus.

Mr. Nasmyth expressed his very strong conviction of the total absence of water, or of traces of watery action, on the moon, and also of the absence of any atmosphere. The sudden disappearance of stars behind the moon, without any change or diminution of their brilliancy, was one of the most beautiful phenomena that could be witnessed.

ON THE ORIGIN OF COAL FIELDS.

In a recent lecture before the Royal Institution, by Sir Chas. Lyell, on the origin of coal fields, the lecturer stated that the force of the evidence in favor of their identity in character with the deposits of modern deltas has increased in proportion as they have been more closely studied. They usually display a vast thickness of stratified mud and fine sand without pebbles, and in them are seen countless stems, leaves, and roots of terrestrial plants, free for the most part from all intermixture of marine remains, circumstances which imply the persistency in the same region of a vast body of fresh water. This water was also charged, like that of a great river, with an inexhaustible supply of sediment, which had usually been transported over alluvial plains to a considerable distance from the higher grounds, so that all coarser particles and gravel were left behind. On the whole, the phenomena imply the drainage and denudation of a continent or large island, having within it one or more ranges of mountains. The partial intercalation of brackish water-beds at certain points is equally consistent with the theory of a delta, the lower parts of which are always exposed to be overflowed by the sea, even where no oscillations of level are experienced. The purity of the coal itself, or the absence in it of

earthy particles and sand throughout areas of very great extent, is a fact which has naturally appeared very difficult to explain, if we attribute each coal-seam to a vegetation growing in swamps, and not to the drifting of plants. It may be asked how, during river inundations capable of sweeping away the leaves of ferns, and the stems and roots of sigillariæ and other trees, could the waters fail to transport some fine mud into the swamps? One generation after another of tall trees grew with their roots in mud, and after they had fallen prostrate, and had been turned into coal, were covered with layers of mud, (now turned to shale,) and yet the coal itself has remained unsoiled throughout these various changes. The lecturer thinks this enigma may be solved by attending to what is now taking place in deltas. The dense growth of reeds and herbage which encompasses the margins of forest-covered swamps in the valley and delta of the Mississippi is such that the fluviatile waters, in passing through them, are filtered, and made to clear themselves entirely before they reach the areas in which vegetable matter may accumulate for centuries, forming coal, if the climate be favorable. There is no possibility of the least intermixture of earthy matter in such cases. Thus, in the large submerged tract called the "Sunk Country," near New Madrid, forming part of the western side of the valley of the Mississippi, erect trees have been standing ever since the year 1811–12, killed by the great earthquake of that date; lacustrine and swamp plants have been growing there in the shallows, and several rivers have annually inundated the whole space, and yet have been unable to carry in any sediment within the outer boundaries of the morass. In the ancient coal of the South Joggins, in Nova Scotia, many of the underclays show a network of stigmaria roots, of which some penetrate into, or quite through, older roots which belonged to the trees of a preceding generation. Where trunks are seen in an erect position buried in sandstone and shale, rooted sigillariæ or calamites are often observed at different heights in the enveloping strata, attesting the growth of plants at several successive levels while the process of envelopment was going on. In other cases there are proofs of the submergence of a forest under marine or brackish water, the base of the trunks of the submerged trees being covered with serpulæ, or a species of spirorbis. Not unfrequently seams of coal are succeeded by beds of impure bituminous limestone, composed chiefly of compressed modiolæ with scales and teeth of fish, these being evidently deposits of brackish or salt-water origin. The lecturer exhibited a joint of the stem of a fresh-water reed *(Arundinaria macrosperma)* covered with barnacles, which he gathered at the extremity of the delta of the Mississippi or the Balize. He saw a cane-brake (as it is called in the country) of these tall reeds killed by salt-water, and extending over several acres, the sea having advanced over a space where the discharge of fresh water had slackened for a season in one of the river's mouths. If such reeds when dead could still remain standing in the mud with barnacles attached to them, (these crustacea having been in their turn destroyed by a return of the river to the same spot,) still more easily may we conceive large and

firmly-rooted sigillariæ to have continued erect for many years in the Carboniferous period, when the sea happened to gain on any tract of submerged land. Submergence under salt water may have been caused either by a local diminution in the discharge of a river in one of its many mouths, or more probably by subsidence, as in the case of the erect columns of the Temple of Serapis, near Naples, to which serpulæ and other marine bodies are still found adhering. Sir Charles next entered into some speculations respecting the probable volume of solid matter contained in the carboniferous formation of Nova Scotia. The data, he said, for such an estimate, are as yet imperfect, but some advantage would be gained could we but make some slight approximation to the truth. The strata at the South Joggins are nearly three miles thick, and they are known to be also of enormous thickness in the district of the Albion mines, near Pictou, more than one hundred miles to the eastward. There appears, therefore, little danger of erring on the side of excess, if we take half that amount, or 7,500 feet, as the average thickness of the whole of the coal measures. The area of the coal-field, including part of New Brunswick to the west, and Prince Edward's Island and the Magdalen Isles to the north, as well as the Cape Breton beds, together with the connecting strata which must have been denuded, or must still be concealed, beneath the waters of the Gulf of St. Lawrence, may comprise about 36,000 square miles, which, with the thickness of 7,500 feet before assumed, will give 7,527,168,000,000,000 cubic feet (or 51,136.4 cubic miles) of solid matter as the volume of the rocks. Such an array of figures conveys no distinct idea to the mind, but is interesting when we reflect that the Mississippi would take more than two million of years (2,033,000 years) to convey to the Gulf of Mexico an equal quantity of solid matter in the shape of sediment, assuming the average discharge of water in the great river to be, as calculated by Mr. Forshey, 450,000 cubic feet per second throughout the year, and the total quantity of mud to be, as estimated by Mr. Riddell, 3,702,758,400 cubic feet in the year. We may, however, if we desire to reduce to a minimum the possible time required for such an operation, (assuming it to be one of fluviatile denudation and deposition,) select as our agent a river flowing from a tropical country, such as the Ganges, in the basin of which the fall of rain is much heavier, and where nearly all comes down in a third part of the year, so that the river is more turbid than if it flowed in temperate latitudes. In reference to the Ganges, also, it may be well to mention, that its delta presents in one respect a striking parallel to the Nova Scotia coal-field; since at Calcutta, at the depth of eight or ten feet from the surface, buried trees and roots have been found in digging tanks, indicating an ancient soil now underground; and in boring on the same site for an Artesian well to the depth of 481 feet, other signs of ancient forest-covered lands and peaty soils have been observed at several depths, even as far down as 300 feet and upwards below the level of the sea. As the strata pierced through contained fresh-water remains of recent species of plants and animals, they imply a

subsidence, which has been going on contemporaneously with the accumulation of fluviatile mud. Captain Strachey, of the Bengal Engineers, has estimated that the Ganges must discharge 4½ times as much water into the Bay of Bengal as the same river carries past Ghazipore, a place 500 miles above its mouth, where experiments were made on the volume of water and proportion of mud by the Rev. Mr Everest. It is not till after it has passed Ghazipore that the great river is joined by most of its larger tributaries. Taking the quantity of sediment at one-third less than that assigned by Mr. Everest for the Ghazipore average, the volume of solid matter conveyed to the Bay of Bengal would still amount to 20,000,000,000 of cubic feet annually. The Ganges, therefore, might accomplish in 375,000 years the task which it would take the Mississippi, according to the data before laid down, upwards of two million years to achieve. One inducement to call attention to such calculations is the hope of interesting engineers in making accurate measurement of the quantity of water and mud discharged by such rivers as the Ganges, Brahmapootra, Indus, and Mississippi, and to lead geologists to ascertain the number of cubic feet of solid matter which ancient fluviatile formations, such as the coal measures, with their associated marine strata, may contain. Sir Charles anticipates that the chronological results derived from such sources will be in harmony with the conclusions to which botanical and zoölogical considerations alone might lead us, and that the lapse of years will be found to be so vast as to have an important bearing on our reasonings in every department of geological science. A question may be raised, how far the coöperation of the sea in the deposition of the carboniferous series might accelerate the process above considered. The lecturer conceives that the intervention of he sea would not afford such favorable conditions for the speedy accumulation of a large body of sediment within a limited area as would be obtained by the hypothesis before stated — namely, that of a great river entering a bay in which the waves, currents, and tides of the ocean should exert only a moderate degree of denuding and dispersing power. An eminent writer, when criticizing, in 1830, Sir Charles Lyell's work on the adequacy of existing causes, was at pains to assure his readers, that while he questioned the soundness of the doctrine, he by no means grudged any one the appropriation of as much as he pleased of that "least valuable of all things, past time." But Sir Charles believes, notwithstanding the admission so often made in the abstract of the indefinite extent of past time, that there is, practically speaking, a rooted and perhaps unconscious reluctance on the part of most geologists to follow out to their legitimate consequences the proofs, daily increasing in number, of this immensity of time. It would therefore be of no small moment could we obtain even an approach to some positive measure of the number of centuries which any great operation of Nature, such as the accumulation of a delta or fluviatile deposit of great magnitude, may require, inasmuch as our conceptions of the energy of aqueous or igneous causes, or of the powers of vitality in any given geological period,

must depend on the quantity of time assigned for their development. Thus, for example, geologists will not deny that a vertical subsidence of three miles took place gradually at the South Joggins during the carboniferous epoch, the lowest beds of the coal of Nova Scotia, like the middle and uppermost, consisting of shallow-water beds. If, then, this depression was brought about in the course of 375,000 years, it did not exceed the rate of four feet in a century, resembling that now experienced in certain countries where, whether the movement be upward or downward, it is quite insensible to the inhabitants, and only known by scientific inquiry. If, on the other hand, it was brought about in 2,000,000 of years, according to the other standard before alluded to, the rate would be only six inches in a century. But the same movement taking place in an upward direction would be sufficient to uplift a portion of the earth's crust to the height of Mont Blanc, or to a vertical elevation of three miles above the level of the sea.

ORIGIN OF MINERAL COAL.

The following communication is furnished by Mr. Whittlesey, the well-known geologist and mining engineer:—

Respecting the vegetable origin of mineral coal, I have since 1838 held the opinion that coal is not due to vegetable matter, or at least the main beds of the carboniferous system are not. About that time I gave my reasons for this conviction, in opposition to my previous views, and in opposition to the unanimous authority of the standard authors, on geology, through a periodical published at Columbus, Ohio.

My doctrine or position was regarded by my geological friends so strange, so heretical, and so far from the science, that many of them, from pure regard for my reputation, begged of me not to publish any thing more on the subject.

There is no English or American book on geology, that I know of, that does not affirm that coal is derived from plants, and this has been a stereotyped maxim, or axiom, passing from book to book, from the earliest geological works.

The *mode* in which this enormous quantity of vegetation was produced, collected, spread out in strata and transformed into coal, has been among authors a continual subject of discussion; but none of these admit a doubt of the fact.

The principal collieries of the world belong to the carboniferous series, which are layers of shale, sandstone, limestone, ironstone and coal, having a central depression that appoaches the form of a basin.

The doctrine of the books is, that all these layers are mineral and sedimentary deposits, *except the layers of coal.*

The beds of coal, it is maintained, are the carbonized residue of either vast layers of timber, or of equally extensive beds of peat. The advocates of both modes of supply are about equal.

My conviction is, that the beds of coal were deposited from water, under the same circumstances as the other beds between which the coal is found.

The numerous analyses of coal show that no timber now existing contains *within itself* the proper quantity of ingredients to form coal. It must, therefore, acquire its ingredients in part from some other source, or a part of those existing in wood or woody fibre must be deposited, and another part of the ingredients remain in excess. There is very little vegetable matter that contains *nitrogen*, and woody fibre has none. In coal, nitrogen is found in notable quantities, at almost every analysis.

Woody fibre seldom furnishes more than 50 per cent. of carbon—coal has from 70 to 90 per cent. The inference that coal was once in a vegetable state arose at first from the fact that the impressions or petrifactions of leaves and trees are abundant in coal strata.

As the impressions of the same trees and leaves are found in the shales and sandstones that overlie and underlie these strata, this fact is equally strong proof that the sandstones and shales are of vegetable origin.

Bitumen is similar in its elements to coal, and it pervades rocks of all ages. It is found as abundant in the Silurian and Devonian strata as in the Carboniferous, and is even seen in the igneous rocks. It exudes from the earth in immense quantities, as at the Dead Sea, in Trinidad, on the McKenzie River, and in the Birman empire.

The limestones of Seyssel, in France, that are newer than the carboniferous, and those of Ohio, Michigan and Wisconsin, that are older, equally produce bitumen enough, if concentrated, to form heavy beds of coal. No vegetable remains are found in these rocks.

If the diffusion of bitumen, extending from the tertiary and lias down to the Cambrian strata, does not entitle it to the name of a *mineral*, why should the oxides or sulphurets, that have no greater range, be regarded as minerals?

The advocates of a supply of timber, to be formed into beds of coal, assert that it was collected on the shores of ancient seas, borne by oceanic currents over the whole surface, settled to the bottom in layers, and was covered with sediment that did not enter the interstices, beneath which it was carbonized. No sea or lake, now in existence, collects from its shores such immeasurable supplies of timber; but, on the contrary, all seas cast their floating trunks upon the strands to rot. The trees brought down by rivers like the Mississippi, the Amazon and the Ganges, come singly, and not in floats or layers; they are, if sunk, buried in silt, and either preserved in kind or decay and disappear. No authenticated case is known of a layer of timber, self-transported, and intombed in mud, that has been converted into coal. It is therefore necessary to attribute to ancient seas and rivers qualities that ours do not possess, and that are purely imaginary, and even contrary to nature. Most of the coal rocks are of *marine origin*, and the great examples of buried timber, in the deltas of rivers, are in *fresh-water* deposits.

The advocates of a supply from peaty matter, originating in marshes,

seem to forget that all coal plants are tropical, and that peat belongs exclusively to the northern temperate and frigid zones. It does not exist in a tropical climate. Peat never occupies vast tracts in basin-shaped layers, but only small irregular cavities, in masses, and not in layers. Peat bogs rest upon rocks of all ages, and of all descriptions, granite, trap, lias, and even drift; coal does not extend below the carboniferous, and is never seen above the drift. In coal fields, there are alternate layers of shale, sandstone, and coal many times repeated, so that 10, 20, and even 50 seams of coal exist, one above another, in the same spot. Was ever a succession of peat bogs seen covered by rock strata?

These are some of the considerations that induce me to give a short, simple and natural solution to the formation of coal strata, and to regard them as *sedimentary deposits* from the same waters that deposited the incumbent and subjacent beds. Carbon, oxygen, hydrogen and nitrogen, the elements of coal, existed bountfully, as minerals, in all geological epochs; consequently bitumen, which is composed of these ingredients, is found in rocks of all ages. It only requires the application to it of the same principle that operated in the segregation or separation into layers of other minerals, such as iron ore, limestone, gypsum, or salt, and we have beds of coal. How bitumen originated, it matters not for the present purpose, if it is *not derived* from vegetable matter. That it is not, is placed beyond reasonable doubt, by its existence in large quantities, in rocks older than land vegetation.

All vegetable tissue contains mucilaginous alkaline salts, lime, soda, and potash, as well as silex, iron, and aluminum. If a mass of timber, or other vegetation, was accumulated, and buried, to undergo the supposed change, its mineral constituents must remain; and the products resulting from it should be caustic like the ashes of wood. The analyses should generally show material quantities of these alkalies. Coal ashes should produce lye for making soap, and should prove as advantageous as manure. Lignite and carbonized wood is no doubt found in the tertiary and drift deposit and in peat bogs, but it has only a very remote analogy to mineral coal. Coal is *laminated* like the slates, as well as bedded and stratified like sandstone. Carbonized wood retains the form of the trunk, like a piece of charcoal from the pit of a coal burner.

I have examined in place specimens of timber, and mostly of the resinous trees, that exist in the drift materials, buried long before the time when man appeared upon the earth, at depths from 20 to 150 feet from the surface, and at points many hundred miles asunder. Not one specimen in twenty is carbonized at all, but merely decayed, and none of them resemble coal. But having already exceeded the length I proposed to myself, I will advance no more reasons why I find it impossible to believe that a large portion of the rocky strata of the carboniferous era was derived from vegetation on the surface of the earth. I omit also my idea as to the most probable manner in which coal strata were produced.

COAL TRADE OF GREAT BRITAIN.

To such an extent has the coal industry of Great Britain developed, that at the present time not less than 37,000,000 of tons are annually raised, the value of which at the pit's mouth is little less than 10,000,000*l.* — at the places of consumption, including expenses of transport and other charges, probably not less than 20,000,000*l.* The capital employed in the trade exceeds 10,000,000*l.* About 400 iron furnaces of Great Britain consume annually 10,000,000 tons of coals, and 7,000,000 tons of ironstone, in order to produce 2,500,000 tons of pig-iron, of the value of upwards of 8,000,000*l.* For the supply of the metropolis alone, 3,600,000 tons of coal are required for manufacturing and domestic purposes; coasting vessels conveyed, in 1850, upwards of 9,360,000 tons to various ports in the United Kingdom, and 3,350,000 tons were exported to foreign countries and the British possessions. Add to this that about 120,000 persons are constantly employed in extracting the coal from the mines, and that in some of the northern counties there are more persons at work under the ground than upon its surface, and some approximate idea will be formed of the importance and extent of this branch of English industry. The extent of the coal areas in the British Islands is 12,000 square miles, annual produce, 37,000,000 tons; of Belgium, 250 miles, annual produce, 5,000,000 tons; of France, 2,000 miles, annual produce, 4,150,000 tons; of the United States, 113,000 miles, annual produce, 6,000,000 tons; of Prussia, 2,200 miles, annual produce, 3,500,000 tons; of Spain, 4,000 miles, annual produce, 550,000 tons; of British North America, 18,000 miles, annual produce not known. The English exports, which in 1840 amounted to 1,606,000 tons, valued at 576,000*l.*, had increased in 1850 to 3,531,000 tons, of the value of 1,284,000*l.* In 1841 the exports to France were 451,300 tons; to Holland ,173,378 tons; to Prussia, 116,296 tons; and to Russia, 77,152 tons. In 1850 they were, to France, 612,545 tons; to Holland, 159,953 tons; to Prussia, 186,528 tons; and to Russia, 235,198 tons.

LARGE SPECIMENS OF COAL.

Among the mineralogical curiosities exhibited at the New York Crystal Palace were four columns of anthracite coal forwarded from Wilkesbarre, Penn., and taken from four overlying seams in the Wyoming Valley. These columns were of the following dimensions: —

1. A single block, 3 feet in height by 2⅞ feet square, from the upper or three-foot stratum, and designed, as are all the different columns, to show the thickness of that vein. 2. A column, in two sections, measuring six feet and a half high, the thickness of the seam from which it is taken. 3. A column, in three sections, nine and a half feet in height, the thickness of that seam. 4. A column, in five benches or sections, measuring thirty

(30) feet in height, showing the thickness of the vein or stratum from which they are taken. 5. A specimen of coal, weighing about eleven (11) tons, taken from the thirty-foot seam, showing the fracture of the coal, and its pure and excellent quality.

COAL FIELDS OF MARYLAND.

Dr. Higgins, State agricultural chemist, reports fifteen veins in the great coal region of Alleghany county, Maryland, many of which, however, have no economical value, as it would cost more to work them than the product would justify. The chief veins are—first, the two-feet vein; second, the three-feet vein; third, the forty-inch vein; fourth, the six-feet vein; fifth, the eight-feet vein; sixth, the big, or fifteen-feet vein. The most important veins, however, and those now worked for exportation, are the big vein, the six-feet vein, and the forty-inch vein. The big vein is considered the most valuable; it contains an average thickness of eleven feet of workable coal. It is estimated that there are in this field 20,000 acres of workable big-vein coal, 80,000 acres of six-feet vein, and 80,000 acres of the forty-inch vein. It will thus be seen that the smaller veins embrace a much larger area than the big vein. They do not suffer so much by denudations.

ON THE CHARACTERISTICS OF THE CARBONIFEROUS FLORA OF OHIO.

At the American Scientific Association, Cleveland, Dr. J. S. Newberry, in a communication on the above subject, said that he had made a comparison of the coal plants of Pennsylvania and such as had already been collected in Ohio, and had been surprised to find so great a discrepancy. Of the species collected, scarcely one in ten were common to the two States. This difference was due partly to the geographical distribution of species which in former epochs, as now, gave to different districts somewhat different floras, but more to the changes which had been effected in the flora of the same surface during the deposition of the different carboniferous strata, giving to the upper beds of coal a very different catalogue of plants from that of the lower ones. In Pennsylvania, the proximity of igneous rocks had nearly obliterated the vegetable impressions from the roof stone of the lower beds; consequently most of the specimens from that State had been collected from the upper beds; while in Ohio the largest collection had been made from the lowest bed in the series, where the flora was much the richest.

The shales and sandstones associated with the lowest stratum of coal in Northern Ohio furnish a greater variety of fossil plants than has, perhaps, ever been found elsewhere within equal geographical and geological limits.

In Europe, rarely more than thirty or forty species accompany a single

coal stratum, the lower beds in a basin being least rich in fossil plants, the number of species associated with each sometimes not exceeding eight or ten.

It is but a few years since the first coal mine was opened in this region, and up to the present time so little of the field has been thoroughly explored that it is quite too early to attempt to estimate the number of species which are here fossilized. He had, however, already formed a catalogue of about 150 distinct species, and had imperfect specimens of many more, all collected from about half a dozen localities within a few miles of each other, and within a vertical range of less than a hundred feet. From the number of species already collected, taken in connection with the fact that the plants of a former world had somewhat the local habitat of those of the present day,—each coal mine having a florula in some respects peculiar to itself, and each new mine that is opened furnishing new species,—it is evident that the fossil flora of this limited district is remarkably rich.

The fossil plants of this region are distributed among forty-one genera. Dr. N. said, that a catalogue of these genera, which he presented, gave a very good generic picture of the flora of the base of the productive coal measures, at least in Ohio—that it was characterized by a large number of species of Sphenopteris, Calamites, Sigillariæ and Lycopodiacæ—that it contained representatives of nearly all the genera of the carboniferous period, and a large proportion of the most highly-organized plants of that era.

For the comparison, so far as made, between the fossil plants of the lower and upper parts of the productive coal measure in Ohio, it would seem that there had been a gradual change in the vegetation of the same surface, both generic and specific—the species of the older beds, almost without an exception, being succeeded by others; while the generic changes were confined to the extinction of a small number with the introduction of others, and a different numerical relation of species prevailed at the different periods.

Brongniart noticed in the coal fields of France that *Calamites* and *Lepipodendra* were most abundant in the lower beds; *Sigillaria* in the middle and upper beds; *Asterophyllites*, and especially *Annularia*, in the upper coal strata.

Dr. N. had found in Ohio that *Calamites*, *Lepidodendron*, *Sigillaria* and *Sphenopteris* were most abundant in the lower beds. *Cyclopteris*, *Annularia*, *Asterophyllites*, *Neuropteris*, *Pecopteris* were most numerous in the middle and upper beds. *Psaronius* peculiar to the upper. That, as far as his observation had extended, the place of *Alethopteris lonchitidis* was at the base of the series. *A. Serlii*, *Neuropteriscordata Pecopteris arborescens*, and *Cyathea*, *Sphenophyllum Schlothimi Dictyopteris obliqua* the middle and upper beds, &c.

Dr. N. said that, in the comparison of American with European fossil plants, a very large proportion of the species collected here were regarded as identical with those of Europe. He thought the matter required a

thorough revision; that, when there had been a more careful comparison of well-characterized specimens, European with American, it would be found that the number of species common to the two continents had been much overrated; that of recent plants, as well as animals, a large number of species were at one time considered common to the two continents; but more recently constant characters had been observed in most of these species which served to separate the one from the other. In recent Cryptogamic botany many species which at first sight seemed identical with those of Europe had been found upon careful study to be specifically distinct. His observation, as far as it had extended, prepared him for the same result following a careful examination of our fossil plants.

He said, that of the new species, of which he now submitted descriptions to the Association, nearly all were from Northern Ohio, which was due to the fact that this region had been most carefully studied by him, and that the specimens from which Brongniart's and Bunbury's descriptions and figures of American fossil plants had been drawn were mostly from the upper part of the series, where, as before stated, the flora was specifically quite different.

ON THE STRUCTURE OF COAL.

At the meeting of the British Association, Dr. Redfern presented a communication respecting the structure of coal, especially that of Torbane Hill, Scotland, which resembles the Albert coal of New Brunswick, and, like that, has been the subject of legal dispute as to whether it were indeed true coal, or only asphaltum, or bitumen. He introduced the subject by observing that for all commercial purposes we know sufficiently well what coal is, notwithstanding the difficulty of framing a correct scientific definition of it, and that the popular acceptation of ordinary terms ought never to give way in courts of justice before differences of opinion amongst scientific men. He stated that it was his intention to bring before the Section a number of facts observed by himself, of which he believed many to be new and of great importance, and to show that all the facts obtained from geological, chemical, and microscopical investigations point to the same conclusions. He then showed that the Torbane Hill coal is laminated, and splits with great ease horizontally, like many Cannel coals, and that, like them, it may be lighted at a candle. In all parts of the bed, stigmaria and other fossil plants occur in greater numbers than in most other coals. They present themselves on all fractured surfaces, either in the form of small angular facets on different planes, or of large surfaces on which very distinct vascular tissue may be easily recognized by a common pocket lens. When the microscopical appearances of a fossil stigmaria are compared with those presented by a section taken in the same direction in any part of the bed, they are found essentially similar; which, when taken with the fact that 65½ per cent. of the mass consists of carbon, is good, if not altogether conclusive, evidence that the whole bed is a mass

of vegetable matter. The author then remarked that the appearances of small blocks of the Torbane Hill and other coals when examined as opaque objects, and of their sections examined with higher magnifying powers, are conclusive as establishing the fact that there are the most decided differences in horizontal and vertical sections, and that these differences are in no wise similar to those presented by sections made in different directions in a piece of wood. Wood consists of fibres and vessels for the most part arranged parallel to each other, so that sections made in the direction of the vessels and fibres show their sides in the form of striæ under low powers, whilst sections made across the fibres and vessels show a number of rings which indicate the position of their ends. Horizontal sections of a bed of coal show a number of more or less circular yellow spots set in a dark mass, in great part composed of fragments of vegetable fibres and membranes; but all vertical sections show elongated yellow spots, separated by dark lines, running in the direction of the laminæ of the bed of coal. Had coal possessed a similar fibrous structure to that of wood, of two vertical sections at right angles to each other, one would have shown a fibrous appearance, the other a series of rings; whereas there is never a difference in vertical sections of coal in whatever direction these may be made. Dr. R. especially directed attention to these conclusions, because they are directly opposed to those arrived at in a paper lately published in the "Transactions" of the Microscopical Society of London. Sections examined by high magnifying powers show the laminæ of the Torbane Hill and other Cannel coals to be made up of rounded yellow bodies, which are flattened in the direction of the laminæ, and contain their gas-giving substance. When the gas has been driven off by heat applied to a thin section, a number of polygonal cavities are left. These are separated from each other by very definite and consistent septa, many of which appear in the substance of the larger yellow masses, and resemble the walls of vegetable cells. In all parts of the Torbane Hill coal the author found a number of spherical or flattened membranous capsules of a reddish-yellow or brown color, having tubercles and hairs externally, and smooth within. These vary greatly in size, measuring from 1-200th to the 1-20th of an inch in diameter. They appear to be spores, such as are commonly found in large numbers in many common coals.

The author concludes that all our coals may be arranged in a scale, having the Torbane Hill coal at the top and anthracite at the bottom. Anthracite is almost pure carbon; Torbane Hill coal contains less fixed carbon than most other Cannels; anthracite is very difficult to ignite, and gives out scarcely any gas. Torbane Hill coal burns like a candle, and yields 3,000 cubic feet of gas per ton, more than any known coal, its gas being also of greatly superior illuminating power to any other.

In Dr. R.'s opinion, the microscopical characters of coal point to its having been formed on the spot in which we find it, to its being composed of a mass of vegetable tissues, of various kinds, separated and changed by maceration, pressure and chemical action, and to the introduction of its

earthy matter, in a large number of instances, in a state of solution or fine molecular subdivision. He knows nothing to countenance the supposition that our coal beds are mainly formed of coniferous wood, because the structures found in mother coal or the charcoal layer have not the characters of the glandular tissue of such wood, as has been asserted. It appears that the geological, chemical and microscopical characters of the Torbane Hill coal are similar to those of other cannels, and that the whole evidence we possess, as to the nature of coal, proves it to have been originally a mass of vegetable matter. The only differences which the Torbane Hill coal presents from others are differences of degree, not of kind. It differs from other coals in being the best gas coal, and from other cannels in being the best cannel.

ON THE OCCURRENCE OF NATURAL COKE IN THE COAL FORMATION.

At a recent meeting of the Boston Natural History Society, Prof. Wm. B. Rogers communicated some observations recently made by him on the *natural coke*, and the associated igneous and altered rocks of the Oolite coal region, in the vicinity of Richmond, Virginia. In the district on the north side of the James River, where the most valuable seam of coke has been explored, it is at present wrought by two vertical shafts. In that nearest the outcrop the coke is reached at 112 feet from the surface, in the other at 207 feet, the dip of the coal measures being nearly west and at a low angle. A third shaft, recently wrought, which lies nearer the margin of the basin than either of the preceding, cuts the stratum of coke at the depth of 90 feet. A bed of whinstone, or coarse gray trap, is intercalated in the coal measures of this part of the basin, intersecting the two first mentioned shafts, but cropping out a little west of the third. This bed is met with in the deepest and most western of the shafts at a distance of about 100 feet from the surface, and is more than thirty feet thick where it is cut through; but in the next shaft it is at a depth of less than 30 feet, and has thinned down to about half the preceding thickness.

One of the most remarkable effects produced by this igneous bed is seen in the stratum of carbonaceous fire-clay which lies next beneath. This, which in the second shaft has a thickness of 11 feet, has been greatly indurated and made to assume a columnar structure, by which the whole mass is converted into a congeries of closely-packed five and six-sided prisms, often quite regular, usually about half an inch in diameter, and always at right angles to the lower surface of the trap.

A portion of this bed, originally occupied by impure coaly matter, presents the same columnar structure, but the material is a compact plumbaginous coke, with much earthy matter intermixed. The general aspect of the gray part of this bed strongly resembles that of the coarser varieties of fire-brick after they have been long exposed to intense heat. This is what might be expected, for in the bed in question we have the

very material of fire-brick, and in the overlying trap we have a source of igneous action, which, in the originally molten condition of this substance, could not fail to work great changes in the contiguous strata. This columnar indurated clay, or natural fire-brick, when recently broken emits a most offensive odor, partly that of sulphuretted hydrogen, and partly, perhaps, caused by a sulphuret of carbon.

At the depth of about seventy feet below the bottom of the trap occurs the bed of natural coke, for the mining of which chiefly these openings have been made. This interval below the fire-clay is occupied by bluish and drab argillaceous and sandy slates, with some coarse sandstone, the former abounding in impressions of plants, among which may be noted Equisetum columnare, Zamites oblusifolius and Tæniopteris magnifolia, forms which many years ago Prof. Rogers pointed out as marking the Oolite age of these coal-bearing strata. The baking action of the trap is curiously shown in all these fossils. The coaly matter of the stems and fronds, when closely examined, is seen to be blebby or blistered. It is, in fact, coke, which, while it retains the outlines and stronger markings of the plant, has, in its partial fusion, obliterated all the finer characters of the organized surface.

The coke, where it has been successfully mined, forms a bed about five feet thick, including but little slate, and presenting a nearly homogeneous mass of a bluish-black color, uniformly vesicular, and light enough to float in water. It retains only a minute fraction of the volatile ingredient of the unaltered bituminous coal of this region, but it ignites readily, and burns like the compacter kind of ordinary coke. Throughout the bed, but especially towards the top, it presents a partially columnar structure. Where this structure is marked, the coke is found to crepitate when heated. In some localities on the south side of the James River, where the whole mass of coal and adjoining shale has been rendered completely columnar, the material in the process of heating breaks up with explosion like the crack of a pistol, at the same time projecting its fragments to some distance from the grate.

The gradually diminishing influence of the trap bed, as we recede downwards, is illustrated by the section in one of the shafts, which embraces a thickness of fifty feet of strata below the seam of coke above described. After passing through indurated fire-clay, lying immediately beneath the coke, we have a thickness of about twenty feet of slates, followed by a thin seam of semi-coke, or coky coal, more bituminous below than at top; and after this, descending through some twenty feet more of slates and sandstones, we come upon a bed of bituminous coal, which appears to have sustained no alteration beyond the development throughout the mass of a columnar structure. In the deepest of the three shafts, the seam, now wrought under the intelligent direction of Col. Worth, corresponds to the coky coal above described, the lower layer retaining much of its original bitumen. In all these workings the gradation of metamorphic influence is beautifully marked within a distance of less than fifty

feet of strata, from the greatly altered shale, or fire-clay, immediately beneath the trap, through the successive slates and coke-seams to the unchanged bituminous coal at the bottom of the section.

EXTENSIVE DEPOSIT OF GYPSUM.

Dr. Shumard, who accompanied Capt. Marcy in his reconnoissance of the head waters of the Red River, thus describes an immense deposit of gypsum in that territory:—

This field is probably the largest in the world, and extends from the Wichita Mountains to within a short distance of the nearest Mexican province. Throughout its entire extent the gypsum presents itself to the surface in such a manner as to be very easily worked, and is of the purest quality. Not unfrequently we travelled for miles over continuous beds, which, from their snowy whiteness, and the great abundance of glittering *selenite (transparent gypsum)* they contained, added greatly to the interest of the scenery; while here and there immense bluffs—often several miles in extent, and thickly capped with the same material—projected to the height of two or three hundred feet above the level of the surrounding country. In many places it was observed to be twenty feet in thickness.

DISCOVERIES IN THE OLD RED SANDSTONE.

During the past season some highly interesting discoveries have been made in the Lower Old Red Sandstone beds of Thurso and Wick, in Scotland. Fossil wood and shells, the existence of which in Caithness was hitherto unknown, have been abundantly found *in situ*, the former at Thurso, and both wood and shells at Wick and in the vicinity, the shells having undergone considerable abrasion. These are facts extremely interesting to geologists, and will doubtless give new life to the explorers of the Old Red Sandstone formation, bestowing, as they do, positive evidence of what has formerly been considered at best but doubtful — the existence of vegetable organisms *of the land* at the Old Red period.

ON THE WATERS OF THE GREAT SALT LAKE, ROCKY MOUNTAINS,

By Dr. L. D. Gale, *(Stansburg's Expedition to the Great Salt Lake*, Philadelphia, 1852.) Amount of solid contents, 22.422 per cent. Specific gravity, 1.170. Composition: —

Chloride of sodium,	20.196
Sulphate of soda,	1.834
Chloride of magnesium,	0.252
Chloride of calcium,	*trace.*

On the Waters of the Warm and Hot Springs of Salt Lake City: by Dr. L. D. Gale, (ibid.) The mineral water of the warm spring has a strong smell of sulphuretted hydrogen. Specific gravity, 1.0112. Solid matter afforded on evaporation 1.08200 p. c. Analysis afforded: —

Sulphuretted hydrogen uncombined, . .	0.037454
" " combined, ...	0.000728
Carbonate of lime precipitated by boiling, . .	0.075000
" magnesia " " . .	0.022770
Chloride of calcium, ...	0.005700
Sulphate of soda, ...	0.064835
Chloride of sodium, ...	0.816600
	1.023087

The Hot Spring has the specific gravity 1.0130, and yielded 1.1454 per cent. solid contents. Composition in 100 parts:—

Chloride of sodium, ...	0.8052
Chloride of calcium, ...	0.1096
Carbonate of lime, ...	0.0180
Chloride of magnesium, ...	0.0288
Sulphate of lime, ...	0.0806
Silica, ...	0.0180
	1.0602

DIMENSIONS OF THE AMERICAN LAKES.

The latest measurements of our fresh-water seas are as follows:—

The greatest length of Lake Superior is 335 miles; its greatest breadth is 160 miles; mean depth 988 feet; elevation 627 feet; area 32,000 square miles.

The greatest length of Lake Michigan is 360 miles; its greatest breadth 108 miles; mean depth 900 feet; elevation 587 feet; area 23,000 square miles.

The greatest length of Lake Huron is 200 miles; its greatest breadth is 160 miles; mean depth 900 feet; elevation 574 feet; area 20,000 square miles.

The greatest length of Lake Erie is 250 miles; its greatest breadth is 80 miles; its mean depth is 84 feet; elevation 555 feet; area 6,000 square miles.

The greatest length of Lake Ontario is 180 miles; greatest breadth 65 miles; its mean depth is 500 feet; elevation 262 feet; 6,000 square miles.

The total length of all five is 1,585 miles, covering an area altogether of upwards of 90,000 square miles.

OBSERVATIONS ON EARTHQUAKES.

A report of a committee of the Institute of France, consisting of MM. Lionville, Lamé, and Elie de Beaumont, on the subject of a theory of earthquakes, has been transmitted to the British Association, for the use of that Society. From a careful discussion of several thousand of these phenomena, which have been recorded between the years 1801 and 1850, and a comparison of the periods at which they occurred with the position of the moon in relation to the earth, M. Perrey, of Dijon, would infer that earthquakes may possibly be the result of an action of attraction exercised by that body on the supposed fluid centre of our globe, somewhat similar to that which she exercises on the waters of the ocean, and the report of the committee of the Institute is so far favorable that at their instance the Institute have granted funds to enable the learned professor to continue his researches. Observations of a similar character are now going on in England, under the auspices of Messrs. Mallet and Milne.

ON THE ANNUAL INCREASE IN THE PRODUCTION OF METALS.

In a recent publication of Mr. J. D. Whitney, entitled, "The Metallic Wealth of the United States described and compared with that of other countries," a general summary is given, accompanied by a tabular statement of the estimated amount and value of metals produced throughout the world in 1854. The metals selected are gold, silver, mercury, tin, copper, zinc, lead, iron. The aggregate of these is as follows: —

GOLD.	SILVER.	MERCURY.	TIN.	COPPER.	ZINC.	LEAD.	IRON.
lbs. troy.	*lbs. troy.*	*lbs. av.*	*tons.*	*tons.*	*tons.*	*tons.*	*tons.*
481,950	2,965,200	4,200,000	13,660	56,900	60,550	133,000	5,817,000

The product of the United States in gold is set down at 200,000 pounds; Australia and Oceanica at 150,000; Russia at 60,000; and Mexico and South America, 47,100. Of silver, the new world supplies 2,473,700 pounds, leaving only the small residue of 491,500 pounds for all other countries. Of mercury, Spain gives the world 2,500,000 pounds, and the United States 100,000 pounds. England and Australia furnish over half of all the copper produced by the world, the present produce of the United States being in this metal only 3,500 tons. Prussia and Belgium furnish four-fifths of all the zinc used in the world, (viz., 16,000 and 33,600 tons.) Lead is distributed between Great Britain, Spain and the United States, in the ratio of 4, 2, 1, (viz., 61,000, 30,000 and 15,000 tons each.) England furnishes more than half the iron of the world, 3,000,000 tons, and the United States 1,000,000 tons. France is the next most productive country in iron, 600,000 tons. Russia produces but 200,000 tons, and Sweden 150,000, quantities bearing a very small relation to the celebrity of product of those countries.

The following table exhibits the comparative value of the metallic productions of different countries, from which may be seen the ratio of their production, as compared first with that of this country taken as the unit, and secondly with that of Great Britain : —

COUNTRIES.	Value of Metals produced.	Ratio of production to that of	
		U. States.	G. Britain.
United States, ...	$79,827,000	1.000	5.6
Great Britain, ...	96,169,800	1.205	.1
Australia, ...	39,428,000	.494	5.12
Mexico, ...	30,480,000	.382	1.3
Russian empire, . . .	25,240,000	.316	1.6
France, ...	15,252,500	.191	4.15
Chili, ...	13,144,000	.165	2.15
Rest of South America, .	16,176,000	.203	1.6
Austrian empire, . . .	11,708,000	.147	1.8
Prussia, ...	9,680,000	.121	1.10
Belgium, ...	9,375,000	.118	1.10
Spain, ...	8,016,416	.100	1.12
Sweden and Norway, . .	5,460,896	.068	1.17
Saxony, ...	1,455,000	.018	1.67
Hartz, ...	1,147,588	.014	1.86
Italy, ...	832,500	.010	1.120
Switzerland, ...	375,000	.005	1.240

The great importance of our own metallic resources will be at once apparent from an inspection of the above table. It will be seen that we are second only to Great Britain in our production, as we are also in our consumption, of the metals.

The two great Anglo-Saxon countries stand far before all others; and Australia, a colony of England, of but few years' growth, is the next competitor on the list. As our production of gold, which now forms so important an item of our mineral wealth, falls off, as it assuredly will, the deficiency may be more than made up by the development of our resources for the production of other metals.

GOLD DEPOSITS OF LOWER CANADA.

The following extract relative to the gold deposits of Canada is taken from the last report of the geologist now engaged upon the survey of the British Provinces :—

" In the month of December a few days were devoted to a further exami-

nation of the distribution of this metal in the eastern townships, and particles of it were found in the valley of the St. Francis, at various intervals. Though the weather was rather adverse to the examination, on account of the cold and frost, yet the results were much the same as those of similar previous explorations farther to the east. One of the positions examined was on the Magog River, above Sherbrooke, where particles were met with in an ancient hard-bound gravel, which probably has never been disturbed since the time when the surface rose from beneath a Tertiary sea. The position is about one hundred and fifty feet above the level of Lake St. Francis at Sherbrooke, and would probably be over six hundred feet above the St. Lawrence at Lake St. Peter. This fact seems to show that the metal is not confined to the lowest parts of the valleys, but will have a distribution coextensive with the original drift of the district. It may be considered that the auriferous drift has now been shown to exist into 10,000 square miles on the south side of the St. Lawrence, comprehending the prolongation of the Green Mountains into Canada and the country on the south-east side of them. In following the range of this drift north-westerly, the researches of the survey have not extended beyond Etchmin Lake; but the general similarity of the rocks beyond renders it probable that little change will be found for a distance extending much farther, perhaps to the extremity of Gaspé. It may be proper to remark that, though the ascertained auriferous area is thus so much increased beyond the measure given in the previous report, no fact has come to my knowledge of sufficient importance to authorize any change in the opinion that has been already expressed, that the deposit will not in general remunerate *unskilled labor*, and that agriculturists, artisans and others engaged in the ordinary occupations of the country, would only lose their labor by turning gold hunters. In the examination of the valley of St. Francis, one of the spots tried was in the immediate vicinity of the quartz vein holding copper pyrites, mentioned in the report of 1847–8. In that report it was stated that the copper pyrites were auriferous; and in corroboration of this fact, a small, uneven, but loose, octohedral crystal of gold was on this occasion obtained from a crevice in a two-inch string of quartz, spotted with copper pyrites, which appeared to be subordinate to the principal vein. This vein occurs in a mass of talcose slate, supposed to belong to the Lower Silurian series; but from a vein on the river Du Loup, specimens of quartz and iron pyrites have lately been shown to me, derived from the clay slates of the Upper Silurian series, and in some of these traces of gold have been met with. The metal thus appears to belong to the veins of both the lower and upper series. If Sir R. G. Murchison's theory be well founded, that the gold, when it was originally placed in vein, occupied only that part of them which was towards the then existing exterior of the earth's crust, the presence of it in the Upper Silurian veins would lead to the conclusion that it should be more abundant in them than the lower; for it is probable that those parts of the lower rocks now found exposed were once covered by the upper, which have been removed

by denudation; and the veins of the lower rocks being but the remaining inferior, and therefore less productive, parts of these veins which once cut, both should be surpassed in richness by those of the upper rocks, which present parts nearer to the original surface. The line of division between the two series of rocks has been given in a former report; and, according to the theory in question, the more productive veins should be met with rather on the south-east of the Green Mountain range than within it."

ON THE DISTRIBUTION OF GOLD.

The following remarks on the distribution of gold are taken from a recent publication of Sir R. G. Murchison:—

"It would ill become any geologist who throws his eye over the gold map of the world prepared by Adolf Erman, to attempt to estimate, at this day, the amount of gold which remains, like that of Australia, undetected in the vast regions of the earth, as yet unknown even to geographers, still less to speculate upon the relative proportions of it in such countries. At the same time, the broad features of the case in all known lands may be appealed to, to check extravagant fears and apprehensions respecting an excessive production of the ore. For we can trace the boundaries, rude as they may be, of a metal ever destined to remain precious on account of those limits in position, breadth and depth by which it is circumscribed in Nature's bank. Let it be borne in mind that whilst gold has scarcely ever been found, and never in any quantity, in the secondary and tertiary rocks which occupy so large a portion of the surface, mines sunk down into the solid rocks where it does occur have hitherto, with rare exceptions, proved remunerative; and when they are so, it is only in those cases where the rocks are soft, or the price of labor low. Further: it has been well ascertained, whatever may have been the agency by which this impregnation was effected, that the metal has been chiefly accumulated towards the surface of the rocks; and then, by the abrasion and dispersion of their *superficial* parts, the richest golden materials have been spread out in limited patches, and generally near the bottom of basin-shaped accumulations of detritus. Now, as every heap of these broken auriferous materials in foreign lands has as well defined a base as each gravel pit of our own country, it is quite certain that hollows so occupied, whether in California or Australia, must be dug out and exhausted in a greater or less period. In fact, all similar deposits in the old or new world have had their gold abstracted from heaps whose areas have been traced and whose bottoms were reached. Not proceeding beyond the evidences registered in the stone-book of Nature, it may therefore be affirmed, that the period of such exhaustion in each country (for the deposits are much shallower in some tracts than in others) will, in great measure, depend on the amount of population and the activity of the workmen in each locality. Anglo-Saxon energy, for example, as applied in California and Australia, may in a few years accomplish results which

could only have been obtained in centuries by a scanty and lazy indigenous population; and thus *the present large flow of gold into Europe from such tracts will, in my opinion, begin to diminish within a comparatively short period.* * * * In conclusion, let me express my opinion, that the fear that gold may be greatly depreciated in value relatively to silver—a fear which may have seized upon the minds of some of my readers—is unwarranted by the data registered in the crust of the earth. Gold is, after all, by far the most restricted—in its native distribution—of the precious metals. Silver and argentiferous lead, on the contrary, expand so largely downwards into the bowels of the rocks as to lead us to believe that they must yield enormous profits to the skilful miner for ages to come; and the more so in proportion as better machinery and new inventions shall lessen the difficulty of subterranean mining. It may, indeed, well be doubted whether the quantities of gold and silver, procurable from regions unknown to our progenitors, will prove more than sufficient to meet the exigencies of an enormously increased population and our augmenting commerce and luxury. But this is not a theme for a geologist; and I would simply say, that Providence seems to have originally adjusted the relative value of these two precious metals, and that their relations, having remained the same for ages, will long survive all theories. Modern science, instead of contradicting, only confirms the truth of the aphorism of the patriarch Job, which thus shadowed forth the downward persistence of the one, and the superficial distribution of the other :— 'Surely there is *a vein* for the silver . . . . The earth hath *dust of gold.*' "

QUICKSILVER DEPOSITS OF CALIFORNIA.

M. D'Wéiny, in a communication to the *Courier des Etats Unis*, furnished the following information relative to the quicksilver deposits of California :—

The annual production of mercury at the mines of Almaden, (Spain,) Idria, (Frioul,) Hungary, Transylvania, Peru, &c., is valued at from thirty to forty thousand quintals, (cwt.) China and Japan also produce an equal quantity of mercury, but, I believe, do not export the article. Notwithstanding this large production, the supply is by no means equal to the demand, and many gold and silver mines have ceased to be worked on account of the scarcity and high price of that metal. The mystery which yet envelops the operations at the mines of New Almaden has prevented me from obtaining accurate returns; but we can to some extent supply that want from our own observations, and enable your readers to appreciate the value of these mines in California. The richest minerals of Europe are those of Almaden and Idria; the first contain 10 per cent. of metal, the latter 8 per cent. The other minerals are less rich. I have analyzed several samples of cinnabar, taken from different spots in New Almaden, and they have yielded from 29 to 72 per cent. The general

average was about 50 per cent.; that is to say, the cinnabar is from 10 to 11 times richer than that of Europe.

I have analyzed the refuse which came from the furnaces at New Almaden, and found 8 and 10 per cent. of mercury. Thus have they thrown aside a mineral as rich as that of Idria and Almaden. The loss of 8 to 10 per cent., combined with an equal loss by evaporation on account of defective apparatus, is a most deplorable waste of the riches of the earth. There are at New Almaden ten furnaces for roasting, more or less imperfect in construction, and which, nevertheless, furnish, if in constant operation, from thirty to thirty-five thousand pounds of mercury weekly. To obtain that amount of metal one hundred thousand pounds of cinnabar are consumed, and from eighteen to twenty thousand pounds of mercury lost from bad management. The following calculation will serve to show at what weekly expense these mines could be worked under a proper system of management:—

Fuel,	$160
Laborers' wages,	1,500
Wear and tear of maahinery,	200
Expense of package, &c.,	500
Interest on capital,	1,500
Total,	$3,800

The above outlay would produce fifty thousand pounds of mercury. This would be working with a very limited capital, and it would be easy to double the product by increasing the capital from eighty to one hundred thousand dollars. I need not say that these calculations are not founded upon any results obtained at New Almaden; I neither know the receipts nor expenses of working those mines. I only wish to render apparent to all the importance to which that branch of metallurgic industry can be raised. But to return to New Almaden: the only important work which exists there is a "rift," or inclined plane, which conveys the mineral to the works. Do they find collections of pure mercury in those mines? We do not know, but think it ought to exist in considerable quantities, and that it would be discovered by well-directed researches. The deposits of cinnabar appear very extensive in the neighborhood of the mines now worked, and we may safely predict that hereafter new and extensive works of a similar character will be established there.

ON THE LEAD MINES OF WISCONSIN.

At the Washington meeting of the American Association, Prof. Daniels, who was intrusted with the geological survey of Wisconsin, gave the following account of the geology of the lead mines of that State:—

The lead, he said, is found in a gray limestone, often 300 feet thick, which is the surface rock. The veins are vertical, so long as they con-

tinue in this rock. At certain points they occupy large fissures or caves in the rock. The galena is in large crystals, clinging to the tops or sides, and perfectly pure — never at the bottom, except as they are broken off and mingled with pieces of broken rock. But when we pass deeper into the Trenton limestone, the veins are oftener horizontal, spread in flat, thin sheets. Here the lead is combined with the oxides and sulphates of iron and zinc — "blackjack" and "dry bones," the miners call it. Heretofore the popular belief was, that the lead failed on striking this blue limestone; but at several points he found that, without being aware of it, the miners had worked past even the limestone into the sandstone, and found rich veins even there. These lateral veins of the blue (Trenton) limestone lie parallel to each other; they extend a great distance, and have been worked for a mile. Prof. Daniels inclined to think that the deeper veins will be found not inferior to those nearer the surface. He found occasional veins of copper, but they were entirely independent of the lead veins. The lead veins are in groups, and their lateral veins seem to connect the larger vertical ones of the same group.

Prof. Hall said, that in 1850 this galena limestone was first identified with the Lower Silurian rocks, and he thought the belts spoken of were all of the same age. This region had never suffered from great pressure below, and he thought that the veins of lead had not been injected into the fissures from below, but must have flowed in from above, while in watery solution. The reason why the veins were horizontal in the blue (Trenton) limestone, was because the fissures in the rock were lateral — not that the veins had been pressed together and thrown up laterally after they were filled. The shale above the lead-bearing rock he supposed to be of the Hudson River group.

ON THE CONNECTION BETWEEN THE RED SANDSTONES OF THE MIDDLE STATES AND CONNECTICUT VALLEY WITH THE COAL-BEARING ROCKS OF EASTERN VIRGINIA AND NORTH CAROLINA.

At a recent meeting of the Boston Soc. of Nat. History, Prof. W. B. Rogers exhibited a series of fossils from the middle secondary belts of North Carolina, Virginia, Pennsylvania and Massachusetts — chiefly, he said, with the view of calling attention to the evidence afforded by some of them of the close relation, in geological age, between what has been called the New Red Sandstone of the Middle States and Connecticut valley, first designated by Prof. H. D. Rogers as the middle secondary group, and the coal-bearing rocks of Eastern Virginia and North Carolina.

Prof. R. referred to the existence in Virginia of three distinct belts of these rocks. The most eastern of these, extending almost continuously from the Appommatox River to the Potomac, includes the coal fields of Chesterfield and Henrico counties. The middle tract, about 25 miles west by south of the preceding, is of much less extent, and has not yet furnished any workable coal seam. Somewhat intermediate in trend to

these is a belt of analogous rocks in North Carolina, commencing some distance south of the Virginia line, and stretching south-westwardly across the State, and for a few miles beyond its limits into South Carolina. This area includes the coal-bearing rocks of Deep River. The western belt extends, with two considerable interruptions, entirely across Virginia, being prolonged towards the south-west in the course of the Dan River in North Carolina, and towards the north-east, through Maryland, Pennsylvannia and New Jersey — forming what is usually called the New Red Sandstone belt.

From an examination some twelve years ago of the fossil plants of the most western of the Virginia belts designated, Prof. Rogers had been led to refer this group of rocks to the Oolite series on or near the horizon of the carbonaceous deposits of Whitby and Scarborough, in Yorkshire. Some years later he discovered many of the same plants in the middle belt of Virginia; and in the summer of 1850 he found several of these plants in the coal rocks of Deep River, in North Carolina. In each of the latter districts we meet with Equisetum Columnare, Zamites, and a plumose plant referred to Lycopodites, and strongly resembling L. Williamsonis, of the Yorkshire rocks. These are among the usual forms occurring in the easternmost of the Virginia belts.

Besides the fossil plants common to these three areas, they contain two species of Posidonomya and two of Cypris. Of the Cypridæ one species has a smooth, the other a beautifully granulated carapace. They are both very small, seldom exceeding 1-30th of an inch in length and 1-70th in width. Both species of Posidonomya differ in proportions from the Pos. Minuta of the European Trias, but one of them strongly resembles the P. Bronnii of the Lias, although of larger dimensions.

Prof. Rogers remarked upon the uncertainty which exists as to the true nature of the small shell-like fossils, which, being assumed as mollusks, have been referred to Bronn's genus Posidonomya. But whatever may be their zoölogical affinities, the fossils now under consideration have great interest, as affording further means, not only of comparing together the mesozoic belts of North Carolina and Virginia before referred to, but of approximating more justly than heretofore to the age of the so called New Red Sandstone, or Triassic rocks, which formed the prolonged belt lying farther towards the west.

In the report of Prof. Emmons, published in the autumn of 1852, mention is made of the remains of Saurians in the Deep River deposits, as well of the Posidonia and Cypris, and of an Equisetites, a Lycopodites and other allied forms, together with a naked, rather spinous vegetable, regarded by him as a cellular cryptogamous plant.

In view of the general identity of the fossils thus far found in the Dry River and Middle Virginia belts with those of the most eastern deposit in Virginia, viz., that including the coal of Chesterfield, Prof. Rogers maintained that the general equivalency of these three eras may be regarded as established, and therefore the Dry River belt of North Carolina,

as well as the Middle Virginia belt, ought to be placed in the Jurassic series, not far probably above its base.

In North Carolina, on the Dan River, where these rocks include one or more thin seams of coal, the same Cypridæ and Posidoniæ are found in great numbers in some of the fine-grained shales and black fissile slates. The latter were noticed as early as 1839 by Dr. G. W. Boyd, while on the Virginia Geological Survey. Regarding this fossil, of which specimens were also obtained about the same time from the middle belt in Virginia, as identical with the Posidonia of the Keuper, Prof. R. had, many years ago, announced the probability that a part or all of the great western belt was of the age of the Trias, instead of being lower in the Mesozoic series.

Specimens of the Posidoniæ and Cypridæ, from both belts in North Carolina, and from the eastern and middle belts in Virginia, were exhibited by Prof. R. at the Albany meeting of the American Association of Science in 1851, for the purpose of showing the close relationship between these deposits in geological time. Among the specimens from the Dan River, Prof. R., on the present occasion, referred to the impression of a Zamite leaf and a joint of Equisetum Columnare. Prof. Emmons, in the report above referred to, speaking of the marly slate of this system, says that "it differs in no respect from that of Deep River, bearing the same fossils, Posidonia and Cypris, in great abundance." In the same belt in Pennsylvania, in the vicinity of Phœnixville, early last spring, Prof. H. D. Rogers discovered Posidoniæ in great numbers in a fissile black slate, and on subsequent examination the same beds were found to contain layers crowded with the casts of Cypridæ. Along with these are multitudes of Coprolites, apparently saurian, resembling in size and form the Coprolites found in the carbonaceous beds on Deep River, and also some imperfect impressions of Zamite leaves. These facts Prof. R. considers sufficient to identify, as one formation, the discontinuous tracts of this belt in North Carolina and Virginia, and the great prolonged area of the so called New Red Sandstone of Maryland, Pennsylvania and New Jersey.

As to the geological date of this belt, Prof. Rogers said that the discovery at various and remote points of its course, of Posidoniæ, Cypridæ and Zamites, most or all of which are identical with these forms in the eastern and middle secondary areas of Virginia and North Carolina, makes it extremely probable that the rocks, formerly referred to the New Red Sandstone, and of late more specially to the Trias, are of Jurassic date, and but little anterior to that of the coal rocks of Eastern Virginia.

Prof. R. considered the occurrence of Cypridæ abundantly in all these belts as a strong evidence of their Jurassic age. While only a few species of Cypridæ and many of the allied genus Cytherina occur in the Silurian and Carboniferous rocks, there is a total absence of these Crustacean remains throughout the series of deposits extending from the base of the Permian to the lower limits of the Oolite. But on entering the latter the Cypridæ reappear and become very abundant, there being no less than twelve species known to belong to the Oolite formations of Europe.

On comparing the silicified wood found in the western and eastern belts, Prof. R. had found their structure to be the same, and to agree very nearly with the fossils figured by Witham, under the name of Peuce Huttonia. As this particular structure does not appear to have been met with below the Lias, and occurs in that formation, it furnishes another argument in favor of the Jurassic age of all these rocks.

Prof. R. added, that he had not found in the New Red Sandstone of Connecticut valley either the Posidonia or Cypris, although he had met with obscure markings which he was inclined to refer to the latter. He had, however, satisfied himself that one of the plants, from the vicinity of Greenfield, in Massachusetts, was identical with the form in the Virginia coal rocks referred to Lycopodites, and probably L. Williamsonis, and that, among the other very imperfect impressions associated with this, was one which he regarded as the leaf of a Zamite.

On the whole, therefore, Prof. R. concluded that the additional fossils from the coal-bearing rocks of Virginia and North Carolina served to confirm the conclusion of their being of Jurassic date, and that the fossils thus far found in the more western belt, and its extension through Pennsylvania and New Jersey, rendered it proper to remove it from the Trias, and place it also in the Jurassic period, a little lower probably than the eastern belts of North Carolina and Virginia; and there would be little doubt, he thought, that the same conclusion would apply to the New Red Sandstone of the Connecticut valley.

MASTODON AND ELEPHAS PRIMIGENIUS.

A letter in the Comtes Rendus, by M. Zygomalas, from Samia, in Greece, states that in the mountain of Antinitra immense numbers of the bones of the mastodon have been discovered. Monsieur Z. also saw, in the stones composing the fortress of Dubon Phourka, the bones of unknown animals, and also fossil plants. The quantity of bones of the mastodon exceed any thing hitherto known on the face of the globe, according to this account.

Fragments of the bones of the fossil elephant, in a good condition, were discovered in the summer of 1853, at Zanesville, Ohio, on the line of the Central Railroad. This is the third of the same species that has been discovered in the same bank within a few years past, the leading features of each being distinctly marked, so as to prove that three, at least, of these extinct animals left their remains within the boundaries of this city. The molar teeth, four in number, all that the species possess, were found in the jaws sound and unbroken, and two weigh twenty pounds each, and two fourteen pounds each. The tusks were not in as good condition, one only being sound enough to bear moving. This one, eight feet in length, measured at its base 26½ inches in circumference, and at the point, eight feet distant, where it is broken off, 16½ inches in circumference, the whole length of which was twelve feet or more.

A discovery of great interest to palæontology has lately been made at the gates of Constantina, (Algeria,) while making a cutting for the improvement of the approaches to that city, where a great part of the skeleton of some gigantic animal was found. The thigh and leg bones, the vertebræ, the ribs, the upper part of the head, and several teeth were in a very good state of preservation. The head is not less than eighty-five centimeters from the teeth to the nape, and forty-eight across the bone of the forehead. The front part of the upper jaw has long teeth, and also tusks, similar to those of a wild boar. The legs of the animal are about the size of a horse; and from the bend of the ribs, it is supposed that its size must have been about four times that of an ordinary ox. Its head is somewhat similar to that of the hippopotamus, and its mouth must have been of extraordinary power. No name can be assigned to this animal, but it is considered probable that it may belong to the numerous family of pachydermes. The ground wherein it was found is composed of a soft calcareous rock of tertiary formation.

A skeleton of a mastodon has been recently discovered in a marsh, about ten miles from Poughkeepsie, New York. Its state of preservation is not known, as it is yet but partially exhumed. This is the second skeleton obtained from the vicinity of this city.

A fossil skeleton of an elephant has recently been discovered by Mr. Campbell, of the Hudson's Bay Company, on the sixty-first parallel of latitude, on the west side of the Rocky Mountain chain, about fifteen hundred feet above the sea-level. The skeleton, when first found, was nearly entire, but unfortunately the greater portion of it was lost in a lake by the carelessness of the Indians employed to transport it to a fur port.

In a recent communication to Silliman's Journal, Mr. W. P. Blake notices a number of instances in which partial remains of the mastodon, and elephas primigenius, have been found in California. The remains, principally teeth, appear to occur over a wide extent of country.

Fossil Bones in California.—Dr. C. F. Winslow, in a letter to the California Farmer, thus speaks of the occurrence of bones, fossils, &c., on the Stanislaus River, California :—About one and a half miles from the Stanislaus we came to the limestone cave, which has been often spoken of, of late, as being the receptacle of human bones covered with calcareous deposits. This we did not enter, for lack of time. We had passed it about half a mile before learning its whereabouts, and as the day was so hot, and the sun advancing, we considered it best to pass without exploring it. This we could dispense with the better, as we met a person who had explored it carefully, and who offered us fragments of human skeletons which he had taken from the cave. These bones were dry and light, and not impregnated or overlaid with calcareous spar, like others which I had seen from the same cave. Heretofore obscurity had surrounded the history of the bones which had been found in the cave. But this person, on returning from the cave, met an old Indian; and having a good interpreter

of the Indian dialect with him, he learned that the bones were of comparatively recent deposit there. The cave is about thirty-five feet deep, is irregular in form, and is not more than twenty feet in extent in different directions. The bones have been all taken away, and the stalagmites also have been broken and removed, so that there is little now to interest one in exploring it. In this vicincity is also another cave, with an entrance rather small, and about one hundred feet deep, from which have been taken some very large and finely-crystallized stalactites. These are all in limestone districts of country, and are cavities hollowed out in this easily soluble material by the long-continued action of water. Last summer I visited a cave in the vicinity of Columbia, formed by the forcible breaking up of the primitive or metamorphic rock by subterranean violence. The hill was rounded over this cave, and the rock broken in various directions, and huge masses were tilted and lodged against each other, so that large caverns existed under the hill, and were connected with each other by low or narrow passages. The whole had been often filled with water, and when a vast reservoir, for mining purposes, immediately over its mouth, suddenly sunk away into it last summer, it was observed that the water obtained an outlet some six miles farther south, from the side of another hill. This circumstance shows a connection of the fractures, and indicates a simultaneous action of force by which some of these hills were elevated. I observed no teeth nor other vestiges of animal remains in that cave, though it had been asserted by the first explorers that the teeth of some large animal had been found there.

The remains of ancient quadrupeds, however, if not found there, are frequently found in the flats of the neighboring regions of country, where the miners are at work in procuring gold. The fire of Columbia burned up many specimens of remarkable organic remains, which had been collected by miners while excavating for gold among the drift of the valleys. Texas Flat seems peculiarly distinguished for these remains. I have now a piece of bone temporarily in my possession, probably a fragment of the lower jaw-bone of a mastodon, from that locality—and a person at Texas Flat assured one of our party that a tusk, nine feet in length, and twenty-seven inches in circumference, had been lying for a twelvemonth on the ground near his cabin, but had been recently removed by some one who felt an interest in collecting such curiosities.

Fossils abound in the drift of all parts of California, from the peninsula on which stands San Francisco, and even in the heart of that city, to the flanks and summits of the Sierra Nevada.

ON METEORIC STONES AND THEIR ORIGIN.

At the Washington meeting of the American Scientific Association, Dr. J. Laurence Smith presented a communication on the above subject.

He exhibited several small meteorites, and some large ones. A fragment of one in his possession he showed, of which the whole body weighed

over 60 pounds. It was found in Tazewell county, Tennessee. A large one from Saltillo, Mexico, lay on the table, weighing 260 pounds.

Mr. Bartlett (Boundary commissioner) had described to him one specimen which weighed 600 pounds, and its greatest length was five feet.

It was long supposed that these bodies were identified with the shooting stars, but that error is of easy demonstration; for in all the periodically returning occasions of shooting stars, there is not a case on record where the fall of a meteoric stone has accompanied them. Then we can obtain the elevation of the shooting stars, and without difficulty learn their velocity. They are often far beyond the circle of our atmosphere, and travel at the rate of sixteen miles a second, while we know that nothing can revolve around the earth at a swifter rate than five miles a second. Shooting stars, then, are cosmic bodies, revolving around the sun as a centre. They are self-luminous too. But meteoric stones could not strike the earth in their fall, coming at the rate of sixteen miles a second, without producing very different impressions from what are recorded of their fall.

They are not of terrestrial origin. The number of those who think that they are is too limited to require a set refutation of that theory.

They are not of atmospheric origin, aggregated from different directions, hardened like hail, though from different causes. Their form forbids that suspicion. Whence, then, are they?

Dr. Smith evidently accepted the "lunar theory." They were masses thrown off with great force from the moon, revolving around that body until in the great eccentricity of their orbits they fall within the circle of our atmosphere; once within which, and with velocity greatly retarded, our earth becomes their centre. They may have been thrown out from the craters of volcanoes a long time ago, and been thousands of years revolving before their orbit brought them in contact with our sphere. Laplace and Arago, who once held this theory, gave it up; but they were compelled to do so, or surrender another belief of theirs, that they are identical with shooting stars. One-twentieth of the surface of the moon is volcanic; and if the craters, as revealed by the telescope, are only in the usual proportion to the height and depth of the volcanoes, there need be no doubt that they have sufficient ejecting force to hurl large masses of volcanic matter to immense distances. Remember, besides, that the attracting power of the moon is but one-sixth that of the earth, and that bodies thrown from its surface experience in consequence but one-sixth the retarding force they would have when thrown from the earth's surface.

Look again at the constitution of the meteorite,—made up principally of *pure* iron. It came evidently from some place where there is little or no oxygen. Now, the moon has no atmosphere, and no water on its surface. There is no oxygen there, then. Hurled from the moon, these bodies—these masses of almost pure iron—would flame in the sun like polished steel, and on reaching our atmosphere would burn in its oxygen until a black oxide coated it; and this we find to be the case with all our meteorites—the black color is only an external covering.

BOTANY.

USE OF THE HORSE CHESTNUT AS FOOD.

The Paris National, October, contains the following account of a discovery recently reported to the French Academy :—

It has long been a problem, one of the desiderata of Agricultural Chemistry, to know how to convert the pulp of the horse chestnut into meal of good quality. These beautiful trees, which are the pride of our parks, have for years strewed the ground with their fruits, which we have trodden under foot without being able to reap the least advantage from them. What is there, however, under the shining shell of the horse chestnut? A mealy substance, enveloped in nitrogeneous membranes—that is to say, matter eminently nutritive; only one particular element, a bitter oil, is secreted in these cells, and communicates to them an insupportable taste. To strip the pulp of the chestnut of the essence which infects it, is, then, a very natural idea, and one worthy to exercise the skill of our chemists; they have essayed very often; they have even succeeded; but it was by expensive proceedings, proper for laboratories, but absolutely inapplicable for common life. A method has at last been discovered by M. Flandin, which he describes as follows :—

Collect some horse chestnuts, and grate them after having taken off the skin; throw on this pulp a little carbonate of pulverized soda. The carbonate of soda is found at any grocery. It costs three cents the pound, and for every hundred weight of pulp two pounds are necessary. Mix these materials well, kneading the pulp with your hands; then you will expose it in a sieve to a current of water like that which issues from the spout of your fountain. Stirring the matter thus moistened, it will pass entirely through the meshes of the sieve, and fall with the waters of washing into a trough placed beneath. Let these waters subside for some minutes; then pour them out by gently inclining the vat. They take with them the bitter oil which has colored them green in dissolving itself, and at the bottom of the vessel is found a fine paste of a brilliant whiteness and very agreeable taste. This is the purified pulp.

The theory of the operation is this: The bitter principle contained in the pulp of the horse chestnut combines itself immediately with the car-

bonate of soda introduced into the paste, forming with its alkali a soluble salt; and the mealy substance, purified by a simple washing, is deposited at the bottom of the vat whence you have gathered it.

ON THE INFLUENCE OF THE SOLAR RADIATIONS ON THE VITAL POWERS OF PLANTS GROWING UNDER DIFFERENT ATMOSPHERIC CONDITIONS.

In a report on this subject, made to the British Association, by Mr. J. H. Gladstone, the author commenced by describing accurately what portions of the prismatic spectrum were cut off by the various colored glasses employed in his experiments. A series of observations followed on hyacinths grown under very varied influences of light, and solar heat, and chemical agency. Among the results may be mentioned the power of the yellow ray to diminish the growth of rootlets, and the absorption of water; the power of the red ray to hinder the proper development of the plant; and the effect of total darkness in causing a rapid and abundant growth of thin rootlets, in preventing the formation of the green coloring matter, but not of that of the blue flower, nor of the other constituents of a healthy plant. A series of experiments on germination was then detailed. Wheat and pease had been grown without soil under large colorless, blue, red, yellow, obscured colorless, and obscured yellow glasses, and in perfect darkness. The effects resulting from these varied conditions were very marked. The two plants experimented on—being chosen from the two great botanical divisions—exhibited a wide diversity, sometimes amounting to a direct opposition, in their manner of being affected by the same solar ray; but in the case of both the plants, under the circumstances of the experiment, the following effects were observed:—The cutting off of the chemical ray facilitates the process of germination, and that both in reference to the protrusion of the radicles and the evolution of the plume: the stem grows unnaturally tall, and there is a poor development of leaves in darkness, becoming more manifest as the darkness is more complete; and the yellow ray exerts a repellent influence on the roots, giving the wheat a downward, and the pea-roots a lateral, impulse. Prof. Miller, in thanking the author for his valuable researches, made some remarks on the interesting results that the investigation had brought to light, and drew especial attention to the remarkable fact stated in the paper, that the blue rays retarded the action of germination at first, although they probably accelerated the growth of the plant afterwards,—the act of germination being attended with absorption of oxygen, but the process of development being, on the contrary, attended with the extrication of this gas. Prof. Anderson remarked, that a similar difference in the rate of growth of the leguminous plants and grasses to that described by Mr. Gladstone had been observed when they were manured with the same material. Nitrate of soda, which was found to be an excellent fertilizer for grasses, had comparatively little influence upon leguminous plants.

THE EFFECT OF COLORED LIGHT ON GERMINATION.

To determine the commercial value of any seeds, one hundred of them are placed in a pot in a stove, made for the purpose of quickening the process of germination. If all the seeds germinate, the seed obtains the highest value in the market. If only eighty germinate, the seed loses 20 per cent. in value. This process ordinarily occupies from twelve to fifteen days; but Mr. Lawson found that by using blue glass they are enabled to determine the value of seed in two or three days: and this is a matter of such commercial importance to them that it is quite equal to a gift of £500 a year.—*Proceedings of the Royal Polytechnie Society.*

NEW AMERICAN GUM.

The Washington Union, Nov. 9, 1854, contains the correspondence between Thomas S. Drew, superintendent of Indian affairs, and others, relative to a recent discovery, which bids fair to be of great importance. Dr. G. G. Shumard, physician and geologist to the Lake Expedition, commanded by Captain Marcy, U. S. A., to the regions of the source of the Big Wachita and Brazos Rivers, in the north of Texas, has discovered a substitute for gum arabic, which he calls "gum mezquite," and which, he has no doubt, will prove a valuable source of revenue to the States of Texas, New Mexico, &c.

In a letter from Dr. S. to Mr. Drew from Fort Smith, he says:—

I comply with your request to furnish, for the use of the Indian department, a short description of the gum mezquite, discovered during our recent expedition to the head waters of the Big Wachita and Brazos Rivers.

This gum, for which I propose the name of gum mezquite, is believed to occur in inexhaustible quantities, and will, no doubt, prove a valuable source of revenue to the States of Texas, New Mexico, and the adjacent Indian territory, besides affording employment to the different tribes of Indians now roving upon the plains, many of whom would, no doubt, be glad to gather and deliver it to the different frontier posts for a very small compensation.

The mezquite tree, from which this gum is obtained, is by far the most abundant tree of the plains, covering thousands of miles of the surface, and always flourishing most luxuriantly in elevated and dry regions. The gum exudes spontaneously, in a semi-fluid state, from the bark of the trunk and branches, and soon hardens by exposure to the atmosphere, forming more or less rounded and variously-colored masses, weighing each from a few grains to several ounces. These soon bleach and whiten upon exposure to the light of the sun, finally becoming nearly colorless, semi-transparent, and often filled with minute fissures. Specimens collected from the trunks of the trees were generally found to be less pure and more highly colored than when obtained from the branches.

The gum may be collected during the months of July, August, and September; but the most favorable period for that purpose is in the latter part of August, when it may be obtained in the greatest abundance and with but little trouble. The quantity yielded by each tree I found to vary from an ounce to three pounds; but incisions in the bark not only greatly facilitated its exudation, but caused the tree to yield a much greater amount. As it is, a good hand would probably be able to collect from ten to twenty pounds in a day. Were incisions resorted to, probably double the amount might be obtained.

Specimens of the gum have been forwarded by Dr. Shumard to Mr. Drew, and are described by the latter as strikingly similar to gum arabic, not only as regards taste and appearance, but as to their mucilaginous qualities. Mr. Drew states: "Upon diluting one ounce of this gum in two ounces of cold water, I had a fine, glutinous paste, which I have used in sealing envelopes and other packages. I have also caused it to be mixed with starch in the application to linen, and, in both instances, have no hesitation in saying that it is equal to the article of which it must soon become a popular substitute."

THE OIDIUM TUCKERI, OR GRAPE MALADY OF EUROPE.

From a paper read before the Royal Institution of Great Britain, by M. Brockedon, we obtain the following information respecting the singular disease which has of late years proved so destructive to grapes of France and other parts of Europe.

It appears to have been first observed in England by an observant gardener of Margate, whose name has been given to the fungus producing the disease, viz., *Oidium Tuckeri*. It is an egg-shaped fungus, one of an immense family of this class of destroyers, but one not before known or recognized; and though it bears a close resemblance to those which are found upon the potato, peach, cucumber, &c., yet it is distinguished from all others by a microscopic observer, and has never yet been found upon any other plant, and, when found upon the grape, has always been destructive. Its first appearance is like a whitish mildew, showing itself principally upon the young grape when about the size of a pea. When the spore of this fungus has settled on the young berry, it enlarges and radiates irregularly in fine filaments, which often cover the whole surface, extending with great rapidity. These fix themselves by imperceptible attachments, which do not appear to penetrate the cuticle; numerous branches from the mycelium are unfruitful; others are jointed, and rise vertically like the pile of velvet; the upper joint enlarges, rounds itself into an elliptical form, ripens, separates, and is carried off with the slightest motion of the air, to find another grape upon which it can be developed. Warmth and moisture favor its rapid fructification; a succession of spores rise from the same branch; and often two, three, or four ripen and disperse almost at the same time. Its effect upon the grape is to exhaust

the juices of the cuticle, which ceases to expand with the pulp of the fruit; it then bursts, dries up, and is utterly destroyed. This fatal disease has returned with increased virulence in each succeeding year. In 1847 the spores of this *Oidium* reached France, and was found in the forcing-houses of Versailles and other places near Paris; but the disease soon reached the trellised vines, and destroyed the grapes out of doors in the neighborhood, and continued to extend from place to place; but until 1850 it was chiefly observed in vineries, which lost from this cause, season after season, the whole of their crops. Unhappily, in 1851, it was found to have extended to the south and south-east of France and Italy, and the grapes were so affected that they either decayed, or the wine made from them was detestable. In 1852, the *Oidium Tuckeri* reappeared in France with increased and fatal energy; it crossed the Mediterranean to Algeria, has shown itself in Syria and Asia Minor, attacked the Muscat grapes at Malaga, injured the vines in the Balearic Islands, utterly destroyed the vintage in Madeira, greatly injured it in the Greek Islands, and destroyed the currants in Zante and Cephalonia, rendering them almost unfit for use, and so diminished the supply that 500 gatherers did the ordinary work of 8000! But it is in France that its frightful ravages are chiefly to be regarded as a national calamity, where the produce of the soil in wine is said to exceed 500,000,000 of hectolitres; two-fifths of the usual quantity of wine made there has been destroyed, and what has been made is bad. It has not touched with equal severity all the departments.

The vineyards of the Medoc in 1851 were untouched, and the cultivators laughed at the existence of the *Oidium;* but last year the disease showed itself every where in the Gironde. The Eastern Pyrenees, l'Aude, l'Herault, and a great part of Gard, were all deplorably affected, and at Frontignan and Lunel the vineyards were abandoned in despair. Thouands of laborers were thrown out of employ, and the distress was awful. Wine in France is the common drink of the peasant; upon this, his bread, and some *legumes*, he labors; but the wine, bad as it is, has risen to double, and in the countries most injured even treble, its ordinary price. M. Möhl has most carefully examined whether the *Oidium* of the grape lives on other plants besides the vine, but he is decidedly of opinion that it does not. Some persons have supposed that it was caused by insects, because occasionally they have been found on diseased vines; but the idea is now utterly rejected, for not the slightest appearance of disease precedes the fungus, which creeps over the epidermis, but does not enter its tissues. It envelops the grape, absorbs the juices of the superficial cells, and stops the growth of the cuticle. The pulp expands within the fruit, bursts longitudinally, its juices are lost, and it dries up. In an early stage of the disease the fungus may be wiped off, and the fruit will come to maturity. The *Oidium* never matures on decayed vegetable substances; it lives and fructifies only on living tissues. The poor peasant of the Bouches du Rhone believes that the cause is bad air; but at Genoa, Grenoble, Lyons, Dijon, and Strasbourg, the people attribute it to gas-

lights and the vapor of locomotives, and think that such inventions are infernal; and many works are published with such absurd imputations, and recommending preventives and remedies just as wise. By many it is asked, Is the *Oidium* the cause, or consequence, of the disease of the vine? The vine, one party says, is over-cultivated and liable to affections which the wild healthy plant resists, and it should be treated as in a state of plethora; tap it, lessen its sap, and it will invigorate so as to resist the poison of the *Oidium*. This has been tried, and failed. If this were the cause, it could not have so suddenly and widely extended itself.

ON THE ORIGIN AND FIRST CAUSES OF THE GRAPE AND POTATO DISEASES.

At the German Association of Naturalists, Dr. Gümpel, of Landau, read a paper "on the Cells, with reference to the origin and first causes of the Grape and Potato Diseases." The author considered it his duty to lay before the meeting the result of his careful investigation respecting the cause of these diseases. After tracing the progessive steps of scientific discovery, three of which he specially alluded to,—viz., the researches of Aristotle, the discovery of painting, and the invention of the microscope,—he attributed to the latter our knowledge of the cells and cellular structure of plants. The great element in the development of vegetable life is the pollen, (Blüthestaub.) The pollen is the great cause of the disease or death of plants; the sound o unsound condition of the pollen influences the whole growth of the plant. The pollen is carried in every direction by the winds; it attaches itself to the leaves, or it falls on the ground. There it bursts, and again distributes its mischievous effects, if unsound, on all around. Thence the difference in the time when the disease shows itself on the grape or the potato, as it can only appear after the flowering, on which depends the healthy or unhealthy state of the plants. He did not explain how the pollen first become diseased, but he thought it might be first developed in the bud. At all events, he concluded, we have now an open, well-known enemy to deal with, and need not fear the existence of a mysterious, unseen, unknown foe in the air.

THE WELLINGTONIA GIGANTEA.

This name has been given by the English botanists to the large coniferous tree recently discovered in California. It inhabits a solitary district on the elevated slopes of the Sierra Nevada, near the head waters of the Stanislaus and San Antonio Rivers, in lat. 38 N., long. 120 10 W., at an elevation of 5,000 feet from the level of the sea. From 80 to 90 trees exist, all within the circuit of a mile, and these varying from 250 to 320 feet in height, and from 10 to 20 feet in diameter. Their manner of growth is much like *Sequoi (taxodium) sempervirens*; some are solitary, some are in

pairs, while some, and not unfrequently, stand three and four together. A tree recently felled measured about 300 feet in length, with a diameter, including bark, of 29 feet 2 inches at 5 feet from the ground; at 18 feet from the ground it was 14 feet 6 inches through; at 100 feet from the ground, 14 feet; and at 200 from the ground, 5 feet 5 inches. The bark is of a pale cinnamon brown, and from 12 to 15 inches in thickness. The branchlets are round, somewhat pendent, resembling a cypress or juniper. The leaves are pale grass green. Those of the young trees are spreading with a sharp accuminate point. The cones are about 2½ inches long and 2 inches across at the thickest part. The trunk of the tree in question was perfectly solid from the sap-wood to the centre; and judging from the number of concentric rings, its age has been estimated at 3,000 years. The wood is light, soft, and of a reddish color, like redwood or *Taxodium sempervirens*. Of this vegetable monster, 21 feet of the bark, from the lower part of the trunk, have been put in the natural form in San Francisco for exhibition; it there forms a spacious carpeted room, and contains a piano, with seats for 40 persons. On one occasion, 140 children were admitted without inconvenience.

A piece of the wood, recently examined by Prof. Gray, of Cambridge, was found to contain on an average 48 annual layers to the inch. The semi-diameter of the tree, at the point where the specimen examined was taken from, being 5 feet 2 inches, (viz., at 25 feet from the ground,) supposing the tree increased in diameter at the same rate during its whole life, there would be nearly 3,000 annual layers; but Dr. Gray, in consideration of the greater thickness of the layers of a young tree, and from comparison of sections of the so called cypress of the Southern States, *Taxodium distichum*, (as given in detail in the Proceedings of the American Academy, vol. 3, p. 96,) assigns about 2,000 years as its highest probable age.

Dr. C. F. Winslow, formerly of Boston, furnishes to the California Farmer the following description of a visit to the localities of these gigantic trees. He says,—"The road was more or less shaded all the way by pines so gigantic as to awaken in me, who had never before seen the native and lofty forest scenery of the north temperate zone, the strongest feelings of wonder and admiration. I had never before conceived of the capacity of the various species of conifera to attain such enormous dimensions. They were often 6 feet through, and from 130 to 300 feet high, and so symmetrical and perfect in form as to impress me with new and more commanding ideas respecting the force and operation of the vital principle presiding over the nourishment and growth of organized bodies.

"The height of the locality is about 5,000 feet above the sea, and 2,400 feet above 'Murphy's Camp,' on the Stanislaus. So far as known, the vegetable growth to which the name of 'Big Tree' has been attached grows in no other region of the Sierra Nevada, nor on any other mountain range of the earth. It exists here only, and all the individuals of its kind, so far as I can learn, are localized to this vicinity. They are embraced within a range of 200 acres, and are enclosed in a basin of coarse

silicious material, surrounded by a sloping ridge of sienitic rock, which in some places projects above the soil. The basin is reeking with moisture, and in the lowest places the water is standing, and some of the largest trees dip their roots into the pools or water-runs. The trees of very large dimensions number considerably more than 100. Mr. Blake measured one 94 feet in circumference at the root, the side of which had been partly burned by contact with another tree, the head of which had fallen against it. The latter can be measured 450 feet from its head to its root. A large portion of this fallen monster is still to be seen and examined; and by the measurement of Mr. Lapham, the proprietor of the place, it is said to be 10 feet in diameter at 350 feet from its uptorn root. In falling it had prostrated another large tree in its course, and pressed out the earth beneath itself so as to be embedded a number of feet into the ground. Its diameter across its root is 40 feet. A man is nothing in comparison of dimensions while walking on it or standing near its side. This to me was the greatest wonder of the forest. The tree which it prostrated in falling has been burned hollow, and is so large, a gentleman who accompanied us from Murphy's informed us, that, when he first visited the place two years ago, he rode through it on horseback for 200 feet, without stooping but at one spot as he entered at the root. We all walked many scores of feet through it, but a large piece of its side has fallen in near the head. But there are many standing whose magnitude absolutely oppresses the mind with awe. In one place, three of these gigantic objects grow side by side, as if planted with special reference to their present appearance. Another, so monstrous as to absolutely compel you to walk around it, and even linger, is divided at from 50 to 100 feet from the ground into three of these straight mammoth trunks, towering over 300 feet into the sky. There are others, whose proportions are as delicate, symmetrical, clean and straight as small spruces, that rise 350 feet from the ground. In one spot a huge knot of some ancient prostrate giant is visible above the soil, where it fell ages ago, and the earth has accumulated so as nearly to obliterate all traces of its former existence. The wood of this tree, I am told by Mr. Lapham, is remarkable for its slow decay. When first cut down its fibre is white, but it soon becomes reddish, and long exposure makes it as dark as mahogany; it is soft, and resembles in some respects pine and cedar. Its bark, however, is much unlike these trees; nearest the ground it is prodigiously thick, fibrous, and when pressed on has a peculiar feeling of elasticity. In some places it is 18 inches thick, and resembles a mass of cocoa-nut husks thickly matted and pressed together, only the fibrous material is exceedingly fine, and altogether unlike the husk of the cocoa-nut. This bark is fissured irregularly with numerous identations, which give it the appearance of great inequality and roughness. A hundred and fifty feet from the ground it is only about two inches thick on the living tree, which is now being stripped of its bark for transportation from the country.

"The cone of this tree is small and compact, and nearly regularly oval; and although the tree itself is the largest of the conifera, its fruit is as

small as that of the dwarfish pines of North Carolina and Cape Cod. Its foliage is not, as a general thing, altogether agreeable to the eye, as the head of the tree is small in proportion to the size and height of the trunk. But the boughs, when examined more closely, are bright-green, rather complicated and delicate in structure, and pleasing to the mind by contrast with the rough and gigantic stem and branch from which they spring.

"The name that has been applied to this tree by Prof. Lindley, an English botanist, is Wellingtonia Gigantea. By him it is declared to be so much unlike other conifera as not only to be a new species, but to require description as a new genus. Other botanists, of eminence, think differently. To this, however, he has seen fit to apply the name of an English hero, a step indicating as much personal arrogance or weakness as scientific indelicacy; for it must have been a prominent idea in the mind of that person that American naturalists would regard with surprise and reluctance the application of a British name, however meritoriously honored, when a name so worthy of immortal honor and renown as that of *Washington* would strike the mind of the world as far more suitable to the most gigantic and remarkable vegetable wonder, indigenous to a country where his name is the most distinguished ornament. If the 'Big Tree be not a Taxodium, let it be called, now and forever, *Taxodium Washingtonium*. If it should be properly ranked as a new genus, then let be called, to the end of time, *Washingtonia Californica*. The generic name indicates unparalleled greatness and grandeur; its specific name, the only locality in the world where it is found. No names can be more appropriate."

EXPERIMENTS IN RAISING POTATOES.

Charles Sears, of the Phalanx Farm, in New Jersey, has communicated to the *Working Farmer* a detailed statement of the result of sundry experiments he has tried in planting potatoes, with a view of determining whether it is most profitable to plant *whole seed*, or small cuttings. The general conclusions are thus stated:—

It will be perceived that the ratio of product to seed is greatest from the smallest cut seed, as might be inferred would be the case; but deducting the quantity of seed in each case, and the net product per acre is uniformly in favor of planting whole seed, and also as clearly in favor of planting large-sized whole seed, when the cost of seed does not exceed a dollar a bushel, and the crop sells for fifty cents or more; the ratio of product per acre of marketable potatoes from whole seed being relatively as 100, 90, 73, and from smallest cut seed as 62, 44, 34. Taking only the first or largest-sized potatoes, the ratio of product per acre from whole seed is as 100, 73, 67.

I have also estimated a money valuation of the crop, and the extreme difference at the prices named between the product of the large-sized whole seed, and that of the smallest cut seed, is as $86, $76 and $40, the latter figure being 46 per cent. of the former.

This experiment was repeated the following year, and when the potatoes were about half grown a protracted drought commenced, and the crop did not attain full size; but so far as could be determined by observation, quite similar results were clearly indicated.

In the foregoing estimation of net results, I have not taken account of the cost of culture and marketing, so as to show the actual profit of the crop, because the cost and product differ so greatly in different sections of the country.

SUBSTITUTE FOR GUTTA PERCHA.

Dr. Riddel, of Madras, has recently found, in making experiments on the muddar plant of India, that its milky juice, when dried, became tough and hard like gutta percha, and precisely analogous to it. It is charred by sulphuric acid, converted into a yellow resinous substance by nitric acid, and but little, or not at all, acted on by muriatic or acetic acid or alcohol. Spirits of turpentine dissolve it into a viscid glue, which, when taken between the thumb and finger, pressed together, and then separated, shows numberless minute threads, all which results correspond with those of gutta percha. The muddar also produces an excellent fibre, useful in the place of hemp and flax. An acre of land cultivated with it would produce a large quantity of fibre and juice.

ON THE PRODUCTION OF MUSHROOMS.

It is the received opinion among botanists that mushrooms have but one sort of seed, and that in this regard Nature has been less kind to them than to seaweeds, mosses, and other crytogams, which she has provided with numerous means of propogation—and yet these are the plants which grow and are reproduced with proverbial rapidity. In examining them more closely than his predecessors, M. Tulasne thinks he has discovered that they are mistaken; that mushrooms, like mosses, possess the faculty of being propagated, not only by filamental elements, but also by buds, and that they have, like some seaweeds, *spores*, or seeds, of two kinds, one being of a higher order than the other, and corresponding to a more perfect mode of multiplying. Independently of all these reproductive organs, M. Tulasne mentions others, the *spermaties*, which are distinguished from the others by their extreme tenuity.—*Proceedings French Academy.*

COLORATION OF SEA WATER.

At certain periods of the year the Red Sea justifies its name by the coloration visible in its waters. M. Ehrenberg ascertained that it then held in suspension prodigious quantities of colored microscopic plants belonging to the seaweed family. From the moment this observation was made, it was deemed that it gave the explanation of a great many accident-

al colorations of sea water observed by travellers. M. Mollien, an ex-consul of France, observed last year that the Sea of China was colored yellow and red over a great space, and that this coloration was not continued, but was in patches separated by a transparent interval. The red color predominated in that part of the sea which bathed the coasts of the southern portion of China, south of the Island of Formosa, while the yellow color predominated north of that island in the portion called the Yellow Sea. He gave to M. Camille Dareste a bottle filled with this colored water, which he had taken in a place where the water was red; it had deposited a sediment of a brownish color, which, examined by the microscope, showed an agglomeration of small seaweeds, more or less decayed, but whose remains were sufficiently perfect to enable M. C. Dareste to ascertain that they belonged to the same species M. Ehrenberg discovered in the Red Sea. We are not able to exhibit so directly that the coloration of the Yellow Sea is caused by an analogous vegetation, but M. C. Dareste indicated a remarkable phenomenon observed by Dr. Bellot, R. N., which would seem to prove this supposition: during a shower of dust there, and which lasted for seven hours, during all of which the wind blew from the sea, (north,) he collected the dust which fell. It was a very fine quartz sand, mixed with filaments of an organic nature, impregnated with soda, and presenting every indication of seaweeds.

VEGETATION UPON THE HIMALAYA MOUNTAINS.

"Rhododendrons occupy the most prominent place, clothing the mountain slopes with a deep-green mantle glowing with bells of brilliant colors; of the eight or ten species growing here, every bush was loaded with as great a profusion of blossoms as are their northern congeners in our English gardens. Primroses are next, both in beauty and abundance; and they are accompanied by yellow cowslips, three feet high, purple polyanthus, and pink large-flowered dwarf kinds nestling in the rocks, and an exquisitely beautiful blue miniature species, whose blossoms sparkle like sapphires on the turf. Gentians begin to unfold their deep azure bells, aconites to rear their tall blue spikes, and fritillaries and *Meconopsis* burst into flower. On the black rocks the gigantic rhubarb forms pale pyramidal towers a yard high, of inflated reflexed bracts, that conceal the flowers, and, overlapping one another like tiles, protect them from the wind and rain: a whorl of broad green leaves, edged with red spreads on the ground at the base of the plant, contrasting in color with the transparent bracts, which are yellow, margined with pink. This is the handsomest herbaceous plant in Sikkim: it is called 'Tchuka,' and the acid stems are eaten both raw and boiled; they are hollow, and full of pure water: the root resembles that of the medicinal rhubarb, but it is spongy and inert; it attains a length of four feet, and grows as thick as the arm. The dried leaves afford a substitute for tobacco; a smaller kind of rhubarb is, however, more commonly used in Tibet for this purpose; it is called 'Chula.'

"The elevation being 12,080 feet, I was above the limit of trees, and the ground was covered with many kinds of small-flowered honeysuckles, barberry, and white rose."—*Sir J. Hooker.*

TROPICAL SCENERY ON THE AMAZON.

Mr. Wallace, a recent traveller in South America, gives us the following highly instructive and well-stated estimate of tropical vegetation. He says :—

"There is grandeur and solemnity in the tropical forest, but little of beauty or brilliancy of color. The hugh buttress trees, the fissured trunks, the extraordinary air roots, the twisted and wrinkled climbers, and the elegant palms, are what strike the attention and fill the mind with admiration, and surprise, and awe. But all is gloomy and solemn, and one feels a relief on again seeing the blue sky and feeling the scorching rays of the sun.

"It is on the roadside and on the rivers' banks that we see all the beauty of the tropical vegetation. There we find a mass of bushes, and shrubs and trees of every height, rising over one another, all exposed to the bright light and the fresh air, and putting forth, within reach, their flowers and fruit, which, in the forest, only grow far up on the topmost branches. Bright flowers and green foliage combine their charms, and climbers with their flowery festoons cover over the bare and decaying stems. Yet, pick out the loveliest spots, where the most gorgeous flowers of the tropics expand their glowing petals, and for every scene of this kind we may find another at home of equal beauty, and with an equal amount of brilliant color.

"Look at a field of buttercups and daisies, — a hillside covered with gorse and broom, — a mountain rich with purple heather, — or a forest-glade, azure with a carpet of wild hyacinths,—and they will bear a comparison with any scene the tropics can produce. I have never seen any thing more glorious than an old crab-tree in full blossom; and the horse chestnut, lilac, and laburnum, will vie with the choicest tropical trees and shrubs. In the tropical waters are no more beautiful plants than our white and yellow water-lilies, our irises, and flowering rush; for I cannot consider the flower of the *Victoria regia* more beautiful than that of the *Nymphæa alba*, though it may be larger; nor is it so abundant an ornament of the tropical waters as the latter is of ours.

"But the question is not to be decided by a comparison of individual plants, or the effects they may produce in the landscape, but on the frequency with which they occur, and the proportion the brilliantly colored bear to the inconspicuous plants. My friend Mr. R. Spruce, now investigating the botany of the Amazon and Rio Negro, assures me that by far the greater proportion of plants gathered by him have inconspicuous green or white flowers; and with regard to the frequency of their occurrence, it was not an uncommon thing for me to pass days travelling up the

rivers without seeing any striking flowering tree or shrub. This is partly owing to the flowers of most tropical trees being so deciduous; they no sooner open than they begin to fall; the Melastomas, in particular, generally burst into flower in the morning, and the next day are withered, and for twelve months that tree bears no more flowers. This will serve to explain why the tropical flowering trees and shrubs do not make so much show as might be expected."

ON THE CONTORTION OF LIGNEOUS FIBRES.

At the meeting of the German Association of Naturalists, Prof. Braun, of Berlin, addressed the meeting on the subject of the oblique direction of the fibres, and the consequent twisting or contortion of the trunks of trees, and exhibited preparations illustrating his views. He endeavored to show that the twisting of the wood and cortical fibres was not an accidental circumstance, but universal in the case of certain trees; that in certain trees they always preserved the same direction, but in others assumed, at a certain age, the contrary direction. He concluded by endeavoring to give an anatomical explanation of the phenomeon, in consequence of the longitudinal wood and cortical cells giving way on one side, and thereby producing a diagonal division of the same.

ASSAM TEA.

Some years since an English company undertook the culture of tea in the country of Assam, situated between Bengal and China, on the waters of the Burrampooter. The London papers state that this company has now under cultivation 2,116 "poorahs" of land. Their last crop of tea amounted to 366,587 pounds, or an increase of about 95,000 over that of the previous year. The produce of 1852 realized £25,930, giving 1s. 11½d. per pound net. The directors declared a dividend of five per cent. from the net profits of the last year.

ZOOLOGY.

LIFE AND ITS PHYSICAL ASPECTS.

The following is an abstract of a paper read before the American Association, by Chas. Girard, Esq. :—

Animated beings manifest a twofold nature—one material, the other spiritual. The material or physical nature assumes a form, a shape, peculiar to each species, constituting bodies tangible and visible to the senses. Call the latter an immaterial principle, or spirit, it matters not what, but let it be acknowledged as a condition *sine qua non* of the manifestation of the physical. To it are to be referred the moral acts and the moral tendencies which belong to the domain of moral philosophy.

The different phases through which the physical individual passes, from its formation up to its last stage of existence, constitute the physical aspects of life; or, in other words, the law under which a physical being starts is the law under which it lives during existence.

The author then proceeds to consider the ultimate process of organic life; that is, the elaboration of matter, its assimilation and transformation into the various parts and organs it assumes, dividing his subject into the following heads :—

1st. The organs and tissues are all composed of cells diversely modified.

2d. The first aspect under which an animal manifests itself is a cell.

3d. Its subsequent growth is but a simple multiplication of cells.

4th. The nourishing of the body is the mere replacing of decayed cells by new ones.

Now, if the cell be considered the elementary part of the organic tissues, we can say there are no organic elements; for, however simple a cell may be, its existence implies the presence of two substances or elements—an internal or enclosed substance, and an external or enclosing substance. A cell, therefore, does not arise from one element. Oil or liquid fat and albumen, examined microscopically in their primitive state, exhibit no structure of any kind, but when brought in contact, almost instantaneously, cells are formed. They may then be produced artificially. From experiments made, it has been ascertained that the oil is the enclosed portion of these primordial cells, while the albumen constitutes the enveloping mem-

brane. Cells thus produced artificially, however, though precisely similar to those formed by the natural fabric, will not undergo further progress. Life cannot be imparted artificially; vitality is not within the reach of experiment.

In all organized bodies, however, there is a wearing away of the constituent particles of which their various organs are composed. Each physical or mental exertion involves the destruction of materials, requiring the aid of nourishment to sustain and maintain the balance between the growth and loss of these bodies. Sustenance is necessary, and of the most varied kind. The wants and propensities of the various species of beings are different; different food must be selected by different races, and other means adopted to preserve their perpetuity of existence.

Allusion was also made to the subject of digestion, the formation of chyme, chyle, the lymph, fibrine, blood, and other fluids by which the process of life is maintained, and facts were adduced, showing that the entire economy of organic bodies is but an elaboration of cells, the immaterial or spiritual principle, which resides in them all, disposing of and arranging the cells according to the plan stamped upon each species. The constituents of the blood, its circulation, and the very important part it bears in preserving and maintaining the other functions of the body in a state of health and activity, were made a particular point of consideration.

In speaking of nutrition, the author said, "This is the last word in physiology; the last word of physiology is the first word in clinical medicine—a science which, without the aid of physiology, would be but an art. Surgery or operative medicine rests entirely upon anatomy. The better the human organism is known to the operator, the better will his operations be performed, so that the last word of anatomy will be the first word of surgery. At the bottom of physiology and medicine—clinical and operative—will be found embryology."

NATURAL HISTORY OF CENTRAL AFRICA.

The following extracts from a letter received from Dr. Vogel, the astronomer and naturalist, now at Lake Tsad, give a characteristic description of those countries and its productions:—

"This is really a terrible country. Whoever expects to meet with tropical abundance here will be sadly disappointed. With the greatest assiduity, for a period of nearly five weeks, I have been unable to discover and collect more than seventy-five different plants. The forests, for the most part, consist merely of acacias (only two sorts) and tamarind trees; palms (doona) are only to be found about fifty miles north, on the River Yeou. Not a single tree or shrub is devoid of prickles. Perhaps the land presents a more refreshing prospect after the rainy season, for almost all the grasses and the more delicate plants are already quite burned up by the sun, the thermometer frequently rising above 100° F., even from the beginning of February.

"We feel severely the lack of fruit and vegetables; of the latter there are only tomatoes and onions; and of the former, with the exception of watermelons and breadmelons, there is absolutely nothing which is at all fit to eat; as for the berries used as food by the natives, they would not be given to the cattle at home. Meat and poultry are consequently almost the sole viands, and they are very plentiful and cheap. A fowl may be bought for two needles, a sheep for eighteen pence, and a large ox for six shillings. We live chiefly on fowls, as butcher's meat keeps sweet only a day and a half at the most.

"The soil is capable of all kinds of cultivation, if there were but people here laborious enough to till it. Indigo, cotton, and melons grow wild; rice and wheat could be raised in any quantity: the former is particularly good, but so rare that it is only to be had as a present from the sultan.

"Lake Tsad is not so much a fine clear water, but a morass, extending farther than the eye can reach, and on its banks mosquitoes in indescribable numbers sting man and horse nearly to death. I cannot sleep by the lake unless I get the straw hut which serves me for a dwelling filled to suffocation with smoke, and am compelled to keep up a fire in it for this purpose throughout the whole night. Kuka lies seven English miles west from the lake, and has consequently fewer gnats, but the flies swarm in infinite multitudes. Nature seems to have provided for their destruction two small species of lizards, which run by thousands to and fro upon the walls with inexpressible rapidity, and snap up the insects with singular readiness. The trees are thickly peopled with chameleons. Beetles and butterflies are extremely scarce; of the former I have procured a sight of two species only, of the latter only about ten or twelve, and but one large one among them. On the other hand, the ants and termites are very numerous; they consume all the woollen and linen stuffs, if these are not secured and shut up with the greatest care. They found their way unfortunately into a packet of plants of the desert which I had collected, and made sad havoc with them. The land is also abundantly infested with venomous serpents and scorpions, and with toads from four to five inches in diameter. There is a vast number of elephants and hippopotami by the lake; I have not unfrequently seen from twenty to thirty of the latter together. Lions and leopards are scarcer; I have not had a sight of any of the former, though I have heard them roar plainly enough, but I saw a very fine specimen of the latter only a short time since. I was disappointed, however, of getting a shot at him, as he became aware of my presence when he was about thirty to forty paces off, and retreated with all speed into an impenetrable acacia thicket. Large wild boars (*Phascochærus*) are very plentiful; they live in burrows in the woods. Gazelles and antelopes are likwise very numerous; the last are of two or three species. Wild buffaloes frequent the marshy shore of the lake, and are considered a good booty, on account of their flesh and hide."

ON THE NIAM-NIAMS, OR MEN WITH TAILS.

Was Lord Monboddo right, after all, about men having tails? Prof. Owen, to be sure, labored in the British Association, in its recent meeting, to demolish the notion of his lordship, and of many eminent *savans*, that man is only an improved monkey. But here is a book just brought out at Paris, and making, we hear, considerable sensation in that capital, which proves, or at least asserts, that our relationship to monkeydom is considerably eloser than the learned professor will allow; inasmuch as there exists at least one portion of our species who are ornamented with what is the glorious appendage of the greater part of the monkey tribes—*tails*—real, *bona fide*, vertebral tails.

The reader may be inelined to think that the book in which this singular revelation is made is some vulgar eatehpenny or foolish hoax. But it purports to be the plain and unvarnished narrative of an eminent traveller, sent out by the Freneh government, at its expense, to make explorations in the least known parts of Afriea; and it is certainly published by him with all apparent seriousness. The name of this gentleman is C. L. du Couret, but for peraonal safety in his African voyages he found it neeessary to disguise his nationality and abjure his religion, and he therefore assumed the name on the titlepage of his book—Hadji-Abd-el-Hamed-Bey. The warrant on which he proceeded to Afriea is given; it is dated Paris, the 7th November, 1849, and is signed by M. de Parieu, at that time Minister of Public Instruction. This doeument expressly states that he has been provided with instruetions by the Academy of Seienees of Paris, and it as expressly direets him, amongst other things, "to visit the country of the Ghilanes, where," it says, "he has reason to believe that he will find a race of men with tails, *(hommes à appendice,)* a specimen of whom he saw at Mecca in 1842," and it direets him "to make speeial researches respecting them." Unless, then, we ean suppose that a regular recognized traveller and *savant*, employed by the Freneh government, and eommissioned by the French Aeademy of Seiences—the most distinguished learned body of Europe—ean descend to the pitiful triek of palming a Munehausen tale on the public, we must aeeept this book as a serious narrative, and no hoax.

We translate the author's description of the singular people to whom he introduees us:—

"The Niam-Niams, or Ghilanes, (their name signifies eannibals,) form a raee of men who have a great similitude with the monkey. Shorter than other negroes, they are rarely more than five feet high. They are generally ill proportioned; their bodies are thin, and appear weak; their arms long and lank; their feet and hands larger and flatter than those of other raees of men; their lower jaws are very strong and very long; their cheek-bones are high; their forehead is narrow, and falls backwards; their ears are long and deformed; their eyes small, brilliant, and remarkably restless; their

nose large and flat, the mouth large, the lips thick, the teeth big and sharp, and remarkably white, (they sharpen their teeth.) Their hair is curly, but not very woolly, short, and not thick. What, however, peculiarly distinguishes this people, is the external prolongation of the vertebral column, which in every individual, male or female, forms a tail of from two to three inches long."

Of their way of living, he says:—

"They live in numerous bands, in a completely savage state, without any clothing, and feed on what they get by the chase or fishing, on roots, and on plants and fruits, which without the least labor a bountiful Paradise puts within their reach, and causes to grow spontaneously. They are armed with small lances, bows and arrows, and they poison the latter skilfully; with clubs of very hard wood; with shields made from the skins of the elephant, rhinoceros, hippopotamus, and crocodile; they often seek quarrels with neighboring negro tribes, with the sole object of carrying off their women, to whom they are very partial, their children, and other victims, whom they devour without pity. They are idolatrous. Formerly the Arabs bought great numbers of them from the slave dealers, (djelabs,) but at present they will not take any of them, became the children belonging to this race who were sold to them became, on growing up, dominated by the ferocious instincts natural to their species, and devoured the children of their masters."

The author declares, to his great regret, that he was not able to reach the country of the Niam-Niams; but he says that the existence of the people was confirmed to him, not only by the Arab slave dealers, but by Nubians, Noubahs, Schellouks, Nouerrs, and other tribes of the interior of Africa whom he visited. He, however, *saw* a Niam-Niam at Mecca, and he thus describes him:—

"I resided at Mecca in 1842. An emir, to whom I expressed doubts as to the existence of men with tails, determined to convince me of the reality of the fact. He caused to be brought before me one of his slaves named Bellal, aged 30, belonging to the race of Ghilanes. This slave spoke Arab perfectly, and appeared very intelligent. I conversed a long time with him, and he informed me that in his country people speak a language which, from want of practice, he had completely forgotten; that his countrymen, whose number he calculates at about thirty or forty thousand, adore the sun, the moon, certain fixed stars, and the sources of a great river to which they immolated victims, (probably the sources of the Nile;) that their customary and most agreeable food is raw flesh, and that they prefer it bleeding; that they particularly like human flesh; and that, in their combats with their neighbors, they immolate the prisoners they take, and eat them, without distinction of sex or age; but that women and children are preferred, because their flesh is more succulent.

"This Ghilane had become a Mussulman full of fervor; he had resided in the holy city for more than fifteen years. However, the desire, or rather the necessity, for such it was for him, of eating raw flesh, manifested

itself from time to time; and on such occasions his master, from motives of prudence, did not fail to give him a large piece of raw mutton, which he devoured with rage in the presence of every body. When this frightful appetite came on he tried to combat it, but it was too strong for him. I have often been present at his strange, savage, and disgusting repast; and when I have asked him why he did not attempt to break himself of such a hideous habit, he has answered me, 'I have often endeavored to do so, but have never been able. It is an instinct which I have inherited from my father and mother. In my country every body lives in this way; and if my master were to neglect to satisfy the *penchant* which Nature has given me, I feel that I could not resist the necessity of devouring something, and that I should commit some great crime by attacking a child or a poor creature too weak to resist me.'

"Having asked him if he did not prefer human flesh to that which was generally given to him, and if the latter had the same taste, and was equally nourishing, he answered, that in his country men were eaten, not only to satisfy hunger, but from vengeance; that nothing is so delicious as the blood and flesh of an enemy; and that, though human flesh was preferable to all others, he was fully satisfied with that which was given to him, as it relieved him from the fear of committing a crime.

"Having asked to see him naked, in order to make a drawing of him, he objected for a long time, on account of religious scruples; but at length, by means of a rich present, I persuaded him to strip. I could then contemplate him at my ease without fearing to humiliate him. He was thin, wiry, and strong. His skin was black, shining, and soft as velvet; his arms and legs appeared weak, but nervous and full of muscle, and his ribs could be counted. He was so ugly as to be repulsive; his mouth was enormous, his lips thick, his teeth sharp, strong, and extremely white; he was very active and skilful; and his tail, *rather more than three inches long*, had as much flexibility as that of a monkey."

As if apprehensive of not having his own statements credited, M. de Couret, or, as he prefers to be called, Hadji-Abd-el-Hamed-Bey, does not neglect to quote the testimony of M. F. de Castelneau, another eminent traveller, who was formerly commissioned by the French government to the existence of the tailed Niam-Niams—a testimony not, indeed, based, like his own, on ocular demonstration, but on the statements of persons in whom M. de Castelneau placed the fullest confidence. We remember very well that in 1851 M. de Castelneau published a pamphlet on the subject, and that it was presented to the Academy of Sciences. Our author, Hadji, also states that M. d'Abbadie, another eminent African traveller, likewise heard of and believed in the men with tails, and in 1852 made a communication to the Geographical Society of Paris to that effect. M. Rocher d'Héricourt, who is also a distinguished traveller in the less-known parts of Africa, and the Imaum of Muscat, who was in Paris in 1849, are, moreover, named as having given confirmatory evidence on the subject; and the brother-in-law of the Sultan of Bournou, one Si-el-

Hadj-Mohammed-Ben-Abd-el-Djillil, has not only, says M. du Couret, vouched for the existence of the race, but has stated that the sultan was at one time at war with them, and has sent drawings of several of them to some of the most learned naturalists at Paris.

Whether or not all this testimony be sufficient to prove the existence of a race of men with caudal appendages, is a matter for individual opinion. For ourselves, we will pronounce neither one way nor the other; for if, on the one hand, it be hard to believe that M. du Couret, M. de Castelneau, and other distinguished scientific men, are foolish victims of credulity or dupes of impostors, on the other hand it is not a little singular that the precise whereabouts of the Niam-Niam country is not described, and more singular still, that none of the tailed race should have yet been sent to Europe, though, as we are told in the book before us, they are by no means rare at Mecca, in the towns on the coasts of the Red Sea, and in the Arab slave markets. M. du Couret himself appears to feel this difficulty; for he says, in concluding his work:—

"If, as I hope, I return to Africa, I will not fail to occupy myself anew with this interesting question, and I will spare no pains to bring into France a living Ghilane, if it be possible, or, if not, at least the skeleton of one, in order to convince the most incredulous."—*London Lit. Gazette.*

MAN *versus* APES.

The following is an abstract from a lecture before the British Association, on the "anthropoid apes," by Prof. Owen:—The lecturer—rejecting as far as possible the technicalities which sometimes make scientific discourses repulsive to a mixed audience—proceeded to define the known species of those large tailless apes which form the highest group of their order, (*quadrumana,*) and consequently make the nearest approach to man. He determined the true zoölogical characters of the known orang outangs and chimpanzees as manifested by adult specimens, pointed out the relative proximity of these caricatures of humanity to the human species, and indicated the leading distinctions which separate the most anthropoid of these apes from man. Entering then upon the subject of the varieties of the human race, the professor defined the degree in which the races differed from each other in color, stature, and modifications of the skeleton. He described the probable causes of these varieties, and proceeded to examine how far any of the known causes which modify specific characters could have operated so as to produce in the chimpanzees or orangs a nearer approach to the human character than they actually present. He pointed out some characters of the skeleton of the apes, such, for example, as the great superorbital ridge in the gorilla ape, which could not have been produced by the habitual action of muscles, or by any other known influence, that, operating on successive generations, produces change in the forms and proportions of bones. The equable length of the human teeth, the concomitant absence of any interval in the dental series, and of any sexual

difference in the development of particular teeth, were affirmed to be primitive and unalterable specific peculiarities of man. The difference in the time of disappearance of the suture separating the pre-maxillary from the maxillary bone was not explicable on any of the known causes affecting such character. Teeth, at least such as consisted of the ordinary dentine of mammals, were not organized so as to be influenced in their growth by the action of neighboring muscles; pressure upon their bony sockets might affect the direction of their growth after they were protruded, but not the specific proportions and form of the crowns of teeth of limited and determinate growth. The crown of the great canine tooth of the male Troglodytes gorilla, a large African ape, began to be calcified when its diet was precisely the same as in the female, and when both sexes derived their sustenance from the mother's milk. Its growth proceeded, and was almost completed before the sexual development had advanced so as to establish those differences of habits, of force, and of muscular exercise, which afterwards characterized the two sexes. The whole crown of the great canine tooth was, in fact, calcified before it cut the gum or displaced its small desiduous predecessor; the weapon was prepared prior to the development of the forces by which it was to be wielded; it was therefore a structure foreordained, a predetermined character of the chimpanzee, by which it was made physically superior to man; and one could as little conceive its development to be a result of external stimulus, or as being influenced by the muscular action, as the development of the stomach, the testes, or the ovaria. There was the same kind of difficulty in accounting for the distinctive characters of the different species of the orangs and the chimpanzees as for those more marked distinctions that removed both kinds of apes from them. And, with regard to the number of the known species, it was not without interest to observe that, as the generic form of the quadrumana approached the bimanous order, they were represented by fewer species. The professor then proceeded to demonstrate the unity of the human species by the constancy of those osteological and dental characters to which attention had been more particularly directed in the investigation of the corresponding characters in the higher quadrumana. Man was the sole species of his genus, the sole representative of his order; he had no nearer physical relations with the brute kind than those which arose out of the characters that linked together the great group of placental mammalia called "unguiculata." In conclusion, the professor briefly recounted the facts at present satisfactorily ascertained respecting the comparative antiquity of the quadrumana and of man upon the surface of the earth. At the time of the demise of Cuvier, in 1832, no evidence had been obtained of fossil quadrumana, and the baron supposed that both these and the bimana were of very recent introduction. Soon after the loss of that great reconstructor of extinct species, evidence with regard to the fossil quadrumana was obtained from different quarters. In the oldest tertiary deposits in Suffolk, specimens of jaws and teeth were found that unmistakably indicated the former existence of a species of monkey of the genus

Macacus, (Macacus cocenus.) About the same time, the tertiary deposits from the Himalayan mountains gave further evidence of the quadrumana; jaws, astragali, and some other parts of the skeleton having been found completely petrified, and referable to the genus called Semnopithecus, which was now restricted to the Asiatic continent. Dr. Lund discovered in Brazil fossil remains of an extinct platyrhine monkey, surpassing any known cebus or mycetes, in size similar to the platyrhines which were now peculiar to South America. Lastly, in the middle of the tertiary series in the south of France was discovered a fragment of the lower jaw, proving that at that period some species of the long-armed ape (Hylobates) must have existed. But no fossil human remains had been found in the regularly deposited layers of any of the divisions of the tertiary series. Human bones had been found in doubtful positions, geologically considered, such as deserted mines and caves in the detritus at the bottom of cliffs, but never in tranquil, undisturbed deposits participating in the mineral characters of the undoubted fossils of those deposits, the petrified negro skeletons in the calcareous concretes of Guadaloupe being undoubtedly of comparatively recent origin. Thus, therefore, (concluded the professor,) in reference both to the unity of the human species, and to the fact of man being the latest, as he was the highest, of all animal forms upon our planet, the interpretations of God's works coincided with what had been revealed to us as to our own origin and zoölogical relations in his word. Of the nature of the creative acts by which the successive races of animals were called into being we were ignorant. But this we know: that, as the evidence of unity of plan testified to the oneness of the Creator, so the modifications of the plan for different modes of existence illustrated the beneficence of the Designer. Those structures, moreover, which were at present incomprehensible as adaptations to a special end, were made comprehensible on a higher principle, and a final purpose was gained in relation to human intelligence; for, in the instances where the analogy of humanly-invented machines failed to explain the structure of a divinely-created organ, such organ did not exist in vain, if its truer comprehension in relation to the divine idea led rational beings to a better conception of their own origin and Creator.

GUANO DEPOSITS OF THE ATLANTIC.

It is now well known that the guano of the Chincha Islands and other sources, under rainless skies, is a product of a peculiar fermentation, in which ammoniacal salts and nitrogenous products are formed from a variety of animal matter. Not only the dung, bodies and eggs of several varieties of birds, but a large amount of flesh and bones of seals, make up the substance of the decomposing mass.

On the islands of the Atlantic, the dung, bodies and eggs of birds are found; but the frequency of rain modifies the decomposition, so that the resulting matter differs essentially from that of the Peruvian shores. It

possesses, however, a high value in special applications, and presents some interesting scientific points.

Dr. A. A. Hayes, of Boston, has fully investigated the composition of the guanos of different islands, including ancient as well as recent deposits. On some of these, two species of birds are still found, in countless numbers, which make daily additions to the accumulated remains of former years.

The substance of this kind of guano is matter derived from the fish food of birds. Its color is light yellowish brown, becoming, when air dried, nearly white. It has no ammoniacal odor, but smells strongly of freshly-disturbed earth. It is never so finely divided as the Peruvian, its particles being sometimes as coarse as mustard seed, resembling closely the sand from Oolite limestone. There is, however, always some finely-divided organic matter, in the slate of humus, either between the particles, or making part of the substance of them. An average composition is the following :—

Moisture, after being air dried,	4.40
Organic matter, crenates, humates, oleates and stearates, magnesia and lime,	6.40
Bone phosphate of lime,	46.60
Carbonate of lime,	39.80
Phosphate magnesia,	1.20
Sulphate lime,	.80
Sand,	.21
Traces of chloride and sulphate of soda,	–
	99.41

The carbonate of lime here given is an essential part of each particle of the bone remains, and does not exist—excepting occasionally as mixture, to the amount of one or two per cents—independently. The humic acid is often in union with ammonia and magnesia, the whole percentage of ammonia, or rather nitrogen, not exceeding in the ancient deposits more than two per cent. A more solid aggregate of grains afforded :—

Moisture from air dried state,	5.40
Organic matter, humates, humus,	–
Oleates and stearates,	8.40
Bone phosphate lime,	64.80
Carbonate of lime,	16.20
Sulphate,	2.80
Phosphate magnesia,	1.60
Sand,	.46
	99.66

The grains adhered slightly; the dry mass was of a pale nankin color, and exhibited the first step in a change, which results in a consolidation of the arenaceous remains into a solid rock.

It will be observed that, if we omit the moisture and organic matter, there are 75 parts of bone phosphate of lime in 100 of the dry guano, constituting a source of this prime requisite in the constitution of fertile soils highly important. From the nature of the decomposition, this bone phosphate is soluble to some extent in water, and thus adapted to application when the immediate effects are desired.

Comparing the composition here given with that of fish bones, we observe an increased amount of phosphate of lime, and are led to the consideration of the cause of this anomalous composition.

Another variety of this guano appears as a solid compact rock, banded in lines by dark-brown colors. Although the irregular forms of the masses mark it as an aggregate, its hardness, next to that of feldspar, and greater than that of fluorspar, removes it from the class of ordinary calcareous aggregates. But the chemical composition is more remarkable.

One hundred parts afford:—

Moisture from air dried state,	0.80
Organic matter and water,	11.00
Bone phosphate of lime,	110.20
Sulphate of lime,	7.90
Sand and dirt,	.80
	130.70

The 50.47 parts of phosphoric acid are, for convenience of comparison, supposed to be united with lime to constitutue bone phosphate of lime. For economical purposes, it is necessary to grind the masses to a fine powder; it then dissolves slowly in water.

This compound generally forms a covering of 10 to 24 inches thick, over the guano on those islands not frequented by birds. Some rough masses are found in the mass of the arenaceous guano, but they appear to have been once a surface covering.

Dr. Hayes explains the singular composition of this aggregate and the guanos more rich in bone phosphate than the bones of birds by referring to the *kind* of fermentation which organic animal matter undergoes in presence of excess of humidity. Briefly, it is the reverse of that which produces ammonia salts in the Peruvian guano, acids being the result here. The whole series of acids, the products of humus decomposition, carbonic acid, and probably acetic acid, being generated in the mass, have dissolved the carbonate of lime of the deposit, while the resulting salts have been washed away by the rains, leaving the phosphate of lime in excess. Where daily depositions are taking place this effect does not follow, as the first decomposition produces ammonia; but under other conditions the carbonate of lime of the bony structure is removed, and the phosphate is left in excess.

The occurrence of rocky masses at the surface is explained by the well-known fact that the solutions of salts formed tend to the surface; and as

the water evaporates under the sun's rays, the earthy salts dissolved by the acid fluids below are left in the interstices existing in the sand like deposits of food remains until they are filled and every trace of granules obliterated. The increased amount of sulphate of lime, the uniform acid state of these guanos and cavities lined with crystals, are all according facts in favor of the conclusion adopted. The experiments, in their extended application to other aggregates, are proving that many compact rocks may be formed at common temperatures, by a similar action, not always involving a chemical solution of the materials.

REMARKABLE CHANGE IN THE COMPOSITION OF THE COCHITUATE WATER SUPPLIED TO THE CITY OF BOSTON.

Dr. A. A. Hayes, at a late meeting of the American Academy, read a paper on the subject of the chemical changes which have taken place in the composition of this water.

Prior to the 1st of November, his weekly testings of this water showed that the ordinary products of humic decomposition did not appear, while crenic acid and crenates became very abundant, at one time exceeding *nineteen times* the weight of the minimum quantity. An earthy odor accompanied the change, and this was soon replaced by an odor resembling that of fish, or fish oil. Analysis showed the presence of an oxidized oil, while the odor could be condensed from the vapor of the water and exhibited apart. This condensed in water would putrefy in the lapse of a few days, and the water itself enclosed would rapidly undergo fermentative changes, the oil remaining.

Repetitions of the experiments on the water soon proved that even coarse filters of cloth would remove matter from the water, which was evidently the source of the peculiar fish-like odor, often confounded with the taste. The more accurate separations were made by means of displacers, filled with powder of animal charcoal recently calcined. All the water entering the charcoal was previously strained, and the charcoal, without removal, was lightly washed with alcohol, and the latter displaced by ether, when a solution of yellowish or brownish fatty matter was obtained. This had the odor of fish oil, but was in the state of a mixture of oily acids, united to a base, either lime or ammonia, often a true adipocere. Acids eliminated a fluid oil, of about the same sp. gr. as lard oil, readily soluble in carbonate of soda solution, forming soap ; alcohol dissolved it freely also.

The water was meantime changing the composition of its organic matter, the usual apocrenates becoming less rare and the quantity of organic matter diminishing. Oxygen gas also appeared in far larger quantity, but the odor and oil still continued to infect the water.

Late in December it was found that an enormous increase of animalcules took place, the cyclops and daphnia predominating, although the temperature of the water was below 40° F. When arrested by a coarse filter, these crustacea appeared to the naked eye of different colors, and

were so distended as to have a gelatinous form, like broken-down tissues of fish. Water freed from these had no odor, while the mass on the filter not only had a strong fish-like odor, but would impart it to other water. The oil could be abundantly obtained from this deposit, and repeated trials showed that this *was the source of the odor and taste of the water.*

Dr. Hayes having carried to Dr. John Bacon his results and specimens for microscopical examination, Dr. Bacon immediately pointed out the two species cyclops and daphnia, whose bodies seemed to be filled with oil. He then removed under the microscope the oil which had the physical characters of that obtained from the filter mass. The color of the oil in the different individuals varied from *red* to *a pale yellow.* Other experiments confirmed the observations made by means of the microscope, and proved that there was no other source of the odor and oil existing in the water. Dr. Bacon has thus proved that these crustacea, before known as carnivorous, are truly, under present circumstances, *oil producers*, doubtless simply assimilating the food they select. The general result of both chemical and microscopical examinations is, that the odor, taste, and oil of the water are due exclusively to the live, dead and decomposing animalcules of the two species named.

Dr. Hayes suggested the simple and practical plan of restoring the water to its natural state, by the introduction of several varieties of fresh-water fish into the lake and receiving basin at Brookline, and the enacting of statutes to prevent them from being caught.

The natural balance between the orders of beings found in the water being thus established, there is no reason for supposing that a similar change would again occur.

NOTICE OF THE "FOUNTAIN OF BLOOD" IN HONDURAS.

The following letter from E. G. Squier, addressed to B. Silliman, Jr., refers to a remarkable phenomenon in Central America, the details of which are sufficiently given in the letter of Mr. Squier. The bottle of colored liquid which was placed by this gentleman in our hands has suffered the same fate as its predecessors, and its contents were so far changed by decomposition as to preclude all attempts at an accurate examination. The color of the fluid was dark brown, exhaling an offensive odor, and having a sediment somewhat copious, in which the microscope detected no distinct forms of organization, although filaments of organic matter were abundant. The most probable conjecture as to the origin of this fluid appears to be that which refers its color to the presence of some highly-colored species of infusoria. A microscopic examination on the spot, or a portion of the material in alcohol, would easily settle this question. Meanwhile the following facts will be read with interest:—

My dear Sir:—I send you herewith a bottle of a remarkable liquid, obtained from what is called "*Mina o' Fuente de Saugre,*" Mine, or Fountain of Blood, in Central America. The locality is a small cavern,

near the little town of Virtud, department of Gracias, State of Honduras, on the western or Pacific slope of the Cordilleras. It has long been known, not only in its immediate vicinity, but in connection with various superstitious hypotheses, throughout all Central America. Mention is made of it in publications dating more than a hundred years. The following extracts from the "Gaceta de Honduras" of the 20th of February, 1853, will serve to give the essential facts concerning it, so far as they are known :—

"*Fuente de Saugre.*—A little to the south of the town of Virtud is a small cavern, which is visited during the day by buzzards and *gabalines*, and at night by a large number of bats, (vampires,) for the purpose of feeding on a kind of liquid which exudes from the rocks, and which has the color, smell, and taste of blood. A rivulet flows near this grot, which is constantly reddened by a small flow of the liquid. A person approaching the grot observes a disagreeable odor; and when it is reached he sees several pools of blood, in a state of coagulation. Dogs eat it eagerly. The late Don Rafael Osejo undertook to send some bottles of this liquid to London for analysis; but it corrupted within twenty-four hours, bursting the bottles."

At my request, a gentleman of an observing turn, living not many leagues from Virtud, sent me two bottles of this liquid, largely diluted with water, to avoid the catastrophe which happened M. Osejo, and to all others who had attempted to carry any portion of the supposed blood out of the country. One of these bottles, as I have already said, I send you for examination.—*Silliman's Journal*, November, 1854.

EXPERIMENTS ON THE SPINAL MARROW.

At a recent meeting of the French Academy, Dr. Schiff read a paper and performed some interesting experiments on the transmission of sensitive impressions in the spinal marrow. In men and the superior orders of animals, the brain sends into the interior of the vertebral column a nervous prolongation, vulgarly called the spinal marrow—an organ whose importance is evidently exhibited by the careful armor of bones which protects it, and by the grave disorders superinduced by every injury received, militating against the integrity of its functions. Anatomy divides the spinal marrow into several distinct parts—a double and a symmetrical organ, whose right and left moieties are separated by a limit traced by Nature, a sort of furrow, (there are two, one anterior, and the other posterior,) which the anatomical student has but to follow with his scalpel to divide the spinal marrow into two equal parts. Each of these parts is divided into three cords, so that there are in all six medullar ribbons—two anterior, two posterior, and two lateral. Nor are these all : when the marrow is transversely cut, the student may observe that the right and left moieties are held together by a connecting substance, which is called the central gray *commissare*, from its being less white than the rest. Here anatomy ends,

and here physiology takes up the theme, and endeavors to add new light to the object. It may not be so sure as anatomy; it is a progressing, a new science; but how great interest is not felt in its least discoveries, as it tries to explain the operations of the organs, or at the least to exhibit the use of their different parts!

One of the most important facts discovered by the experiments of vivisection is the unquestionable difference existing between two sorts of nervous fibres, these being exclusively affected to sensation, and those to motion. The reader will remark, the word *fibre*, and not *nerve*, is used; for, by a very remarkable singularity of organization, most of the nerves which are ramified in the different parts of the body are mixed nerves; i. e., groups of two sorts of fibres so confounded together they cannot be separated; it is only in a very limited portion of their route the fibres of the same species are assembled together. Take at will in the body of a man any nerve large enough to be followed easily towards its origin; the student will be led to the spinal marrow, their common origin, and he will recognize that the nerve is implanted in it by two roots (and not very large) placed behind each other. Of these two roots, the anterior is formed of fibres used to excite motion; in the posterior root, on the contrary, all the fibres are exclusively destined to sensation. Pinch the former in a living animal, there will be convulsive movements; irritate the second, and the animal shows by his cries the pain he suffers; but if the student tries this experiment some centimeters only farther from the conjunction of the two roots, both of these effects will be produced together, for he will be at the same time operating on both species of fibres.

This admirable discovery of Sir Charles Bell has engaged physiologists to endeavor to ascertain whether the marrow itself is not formed of motive and sensitive parts. Their conclusions clash. It appears, indeed, the motive power belongs to the anterior cords, and sensibility to the posterior cords; but these characteristics are not so distinctly defined as in the pair of nerves which emanate from the same cords; for the two opposite regions of the marrow are far from being anatomically isolated, (as the two species of roots are;) besides, the whole organ is subject to reflex actions, which, while they do not equal those of the brain, make the marrow something more than a nerve, and exhibit an intimate union between the parts; lastly, there exists in the centre of the marrow a grayish substance, whose functions had not heretofore been defined, and which might lead to difficulties in the experiments which could not readily be understood. This is the leading object of M. Schiff's memoir. After becoming persuaded that the posterior cord, raised and detached from the rest of the marrow for a certain distance, felt and transmitted sensitive impressions, he made on the grayish substance a series of experiments, which demonstrate that, like the whitish susbtance, it transmits the impression of pain: but when he irritated the substance itself, he ascertained that it remained completely insensible.

This was the most conclusive experiment he exhibited before the Academy

of Sciences. On the table of vivisection there was a rabbit, on which he had made the ablation of the posterior cords of the marrow for a certain distance; below the vection the marrow remained intact, and it was so sensible the animal cried when any thing was placed in the least contact; it was evident the impression passed by means of the gray substance which had been reserved; and yet this grayish substance might be pricked, cut, cauterized or galvanized, without exciting the least sensation; consequently M. Schiff affirms, as demonstrated, that the gray substance, insensible in itself, may nevertheless serve as a conductor to impressions brought by the posterior cords.

HOW TO MAKE SEA-WATER.

Our readers are already aware that the curious family of sea-weeds has been successfully introduced to cultivation, and not in public gardens merely, but likewise as domestic pets, that may in time displace the long-cherished geranium and fuchsia on the mechanic's window-sill. At present, however, this kind of gardening is chiefly occupying the attention of natural history students, who find in the Marine Vivarium an excellent means of observing the development and habits of a class of organized beings, both vegetable and animal, which, as living objects, have hitherto eluded their direct researches. The recent appointment of one of the most distinguished of living zoologists to occupy the chair of Natural History in the Edinburgh University has, during the past summer, had a wonderful effect in arousing the enthusiasm of Scottish naturalists, and of spreading a taste for such pursuits in quarters where it was unknown before. The beautiful zoophytes, crabs, mollusks, and "sea-flowers," collected in the professor's dredging-trips, have put Vivaria greatly into requisition; so much so, that they are becoming by no means unusual drawing-room ornaments in Edinburgh and other parts of Scotland; while in England, the taste for them—emanating from the Regent's Park Zo logical Garden—has advanced with even greater rapidity.

Those naturalists who have the good fortune to reside by the sea-shore are able to give their ocean-treasures a daily supply of fresh sea-water, and thus prererve them in unimpared health. Not so with the unfortunate inland resident, who, despite the best of management, and the nicest "balance of power" between the proportions of animal and vegetable life in his little world, occasionally finds the briny element to lose its sweetnesss, and thus lead to the sacrifice of his long-cherished treasures. To the poet, "a thing of beauty is a joy forever;" but not to the naturalist. "Necessity, however, is the mother of invention;" and Mr. Gosse, as her instrument in the present instance, has pointed out how the inland naturalist may dispense with the ocean, and manufacture sea-water for himself.

But the naturalist and marine-gardener will not be allowed to enjoy a monopoly of this invention. Sea-water has other uses than the nurture of parlor pets in a glass vase; "and uses more important, too," we fancy

whispered by some gouty gentleman, who, throwing physic to the dogs, has given his faith to sea-bathing. Such considerations induce us to bring some of Mr. Gosse's details before the notice of our readers. The inconvenience, delay, and expense attendant upon the procuring of sea-water from the coast or from the ocean, Mr. Gosse long ago felt to be a great difficulty in the way of a general adoption of the Marine Aquarium. "Even in London," says he, "it is an awkward and precarious matter; how much more in inland towns and country places, where it must always prove not only a hinderance, but, to the many, an insuperable objection. The thought had occurred to me, that, as the constituents of sea-water are known, it might be practicable to manufacture it, since all that seemed necessary was to bring together the salts in proper proportion, and add pure water till the solution was of the proper specific gravity. Several scientific friends, to whom I mentioned my thoughts, expressed their doubts of the possibility of the manufacture, and one or two went so far as to say that it had been tried, but that it had been found not to answer; but though it looked like sea-water, tasted, smelt like the right thing, yet it would not support animal life. Still, I could not help saying, with the lawyers, 'If not, why not?'"

Mr. Gosse took Schweitzer's analysis of sea-water for his guide. In one thousand grains of sea-water taken off Brighton, it gave: Water, 964.744; chloride of sodium, 27.059; chloride of magnesium, 3.666; chloride of potassium, 0.765; bromide of magnesium, 0.029; sulphate of magnesia, 2.295; sulphate of lime, 1.407; carbonate of lime, 0.033. Total, 999.998.

The bromide of magnesium and the carbonate of lime he neglected, from the minuteness of their quantities — the former is not found in the water of the Mediterranean — and the sulphate of lime he likewise ventured to omit, on account of its extreme insolubility and the smallness of the quantity contained in the Mediterranean water. The component parts were thus reduced to four, which he used in the following quantities: Common table salt, 3½ ounces; Epsom salts, ¼ ounce; chloride of magnesium, 200 grains troy; chloride of potassium, 40 grains troy. To these four quarts of water were added. The cost was about 5¼d. per gallon; but if large quantities were made, it would be reduced to a maximum of 5d. per gallon.

His manufacture took place on the 21st of April. On the following day he poured off about half the quantity (filtering it through a sponge in a glass funnel) into a confectioner's show-glass, covering the bottom with small shore-pebbles, well washed in fresh water, and one or two fragments of stone, with fronds of green sea-weed (*Ulva latissima*) growing thereon. "I would not at once venture upon the admission of animals," says he, "as I wished the water to be first somewhat impregnated with the scattered spores of the *ulva;* and I thought that, if any subtile elements were thrown off from growing vegetables, the water should have the advantage of it before the entrance of animal life. This, too, is the

order of Nature; plants first, then animals. A coating of the green spores was soon deposited on the sides of the glass, and bubbles of oxygen were copiously thrown off every day under the excitement of the sun's light. After a week, therefore, I ventured to put in animals," consisting of species of *Actinia*, *Bowerbankia*, *Cellularia*, *Balanus*, *Serpula*, &c., along with some red sea-weeds. The whole throve and flourished from day to day, manifesting the highest health and vigor, which induced the addition of extra specimens to the Vivarium.

After the lapse of a sufficient time, to test thoroughly the adaptability of the manufactured water to the exigencies of its inhabitants, Mr. Gosse thus reports: "Six weeks have now elapsed since the introduction of the animals. I have just carefully searched over the jar as well as I could do it without disturbing the contents. I find every one of the species and specimens in high health, with the exception of some of the *Polyzoa* — namely, *Crisea aculeata*, *Cellepora pumicosa*, and *Pedicellina Belgica*. These I cannot find, and I therefore conclude that they have died out; though, if I chose to disturb the stones and weeds, I might possibly detect them. These trifling defalcations do in no wise interfere with the conclusion that the experiment of manufacturing sea-water for the aquarium has been perfectly successful."—*Chambers's Edinburgh Journal.*

EXAMINATION OF SOME DEEP SOUNDINGS FROM THE ATLANTIC OCEAN.—BY PROF. J. W. BAILEY.

In an account of a microscopical examination of soundings made by the U. S. Coast survey near the Atlantic coast of the United States,* I made known that the soundings along the coast, from the depth of 51 fathoms S. E. of Montauk Point to 90 fathoms S. E. of Cape Henlopen, were:—

1080	fathoms,	latitude,	42° 04′	north.
1360	"	"	44° 41′	"
1580	"	"	49° 56′ 30″	
1800	"	"	47° 38′	"
2000	"	"	54° 17′	"

As these soundings are believed to be the deepest ever submitted to microscopic examination, and were obtained at localities far remote from those previously noticed, they were studied very carefully, and the following are the facts ascertained:—

1. None of these soundings contain a particle of gravel, sand, or other recognizable unorganized mineral matter.

2. They all agree in being almost entirely made up of the calcareous shells of minute or microscopic Foraminiferæ, (*Polythalamia*, Ehr.,) among which the species of *Globigerina* greatly predominate in all of the specimens; while *Orbulina universa*, D'Orb., is in immense numbers in some of the soundings, and particularly abundant in that from 1800 fathoms.

* See Smithsonian Contributions to Knowledge, vol. ii. art. 3.

3. They all contain a few species of non-parasitic or pelagic Diatoms, among which were deposits chiefly made up of vast amounts of Foraminiferous shells, rivalling in abundance the deposits of analogous fossil species which I had proved to compose immense beds under the city of Charleston, S. C. None of the species found in the soundings agree with those found in the tertiary deposits of Maryland and Virginia. M. Pourtales states that the greatest depth from which specimens have been brought up in the off-shore soundings of the U. S. Coast survey, and examined, is 267 fathoms, and there the Globigerina are still living in immense numbers. The region of the Globigerina extends to a depth not known.

From the deep sea-soundings made by the U. S. brig Dolphin, under the directions of Lieut. Maury, in longitudes 09°, 13°, 22°, 24° and 29°, west, important results were gathered. In these the *Coscinodiscus lineatus*, *C. eccentricus, and C. radiatus* were most abundant.

4. They all contain a few silicious skeletons of *Polycistineæ*.

5. They all contain spicules of sponges and a few specimens of *Diatyocha fibula*.

6. The above-mentioned organic bodies constitute almost the entire mass of the soundings, being mingled only with a fine calcareous mud, derived from the disintegration of the shells.

7. These soundings contain no species of Foraminifera belonging to the group of *Agathistegues*, a group which appears to be confined to shallow waters, and which the fossil state first appears in the tertiary, where it abounds.

8. These soundings agree with the deep sea-soundings off the coast of the U. S. in the presence and predominance of species of the genus *Globigerina*, and in the presence of the cosmopolite species *Orbulina universi*, but they contain no traces of the Marginulina Bacheii and other species characteristic of the soundings of the Western Atlantic.

9. Examined by chromatic polarized light, the foraminiferous shells in these soundings showed beautiful colored crossings in their cells, and the mud accompanying them also became colored, showing that it is not an amorphous chemical precipitate. It in fact can be traced through fragments of various sizes to the perfect shells of the Foraminiferæ.

10. In the vast amount of pelagic Foraminiferæ, and in the entire absence of sand, these soundings strikingly resemble the chalk of England, as well as the calcareous marls of the Upper Missouri, and this would seem to indicate that these also were deep sea deposits. The cretaceous deposits of New Jersey present no resemblance to these soundings, and are doubtless littoral, as stated by Professor H. D. Rogers, (Proc. Bost. Soc. Nat. Hist. 1853, p. 297.)

11. The examination of a sounding 175 fathoms in depth, made in latitude 42° 53′ 30″ N., longitude 50° 05′ 45″ W., (near Bank of Newfoundland,) by Lt. Berryman, gave results singularly different from those above stated. It proved to be made up of quartzose sand, with a few particles of hornblende, and not a trace of any organic form could be detected

in it. This exceptional result is important, as it proves that the distribution of the organic forms depends on something besides the depth of the water.

12. Connecting the results above mentioned with those furnished by the soundings made in the western portions of the Atlantic, it appears that, with the one exception above mentioned, the bottom of the North Atlantic Ocean, so far as examined, from the depth of about 60 fathoms to that of more than two miles, (2,000 fathoms,) is literally nothing but a mass of microscopic shells.

13. The examination of a large number of specimens of ocean water, taken at different depths by Lt. Berryman at situations in close proximity to the places where the soundings were made, shows that even in the summer months, when animal life is most abundant, neither the surface water, nor that of any depth collected, contained a trace of any *hard*-shelled animalcules. The animals present, some of which are even now alive in the bottles, are all Foraminiferæ and Diatoms, would have left their hard shells if they had been present.

As the species whose shells now compose the bottom of the Atlantic Ocean have not been found living in the surface waters, nor in shallow water along the shore, the question arises, Do they live on the bottom at the immense depths where they are found, or are they borne by submarine currents from their real habitat? Has the Gulf Stream any connection by means of its temperature or its current with their distribution? The determination of these and other important questions connected with this subject requires many additional observations to be made. It is hoped that the results already obtained will induce scientific commanders and travellers to spare no pains in collecting deep sea-soundings. If such materials are sent either to Lt. Maury, U. S. Observatory, or to myself at West Point, N. Y., they will be thankfully received and carefully studied.—*Sill. Jour.*

THE "KILLER WHALE."

At the Washington meeting of the American Association, Lt. Maury stated that Capt. Royes, a New England whaleman, a while since entered Behring's Straits on his cruise. Returning home, the captain wrote him a letter describing the whales which he was acquainted with. There were sixteen kinds that he named, and one of them a strange fish, which the lieutenant did not find named in any of the books. The captain called him the "killer whale," and described him as thirty feet long, yielding about five barrels of oil, having sharp, strong teeth, and on the middle of the back a fin, very stout, and about four feet long. The "killer" is an exceedingly pugnacious fellow. He attacks the right whale, seizing him by the throat, biting till the blood spouts, or till another "killer" comes by and eats out the tongue of the tortured fish, which is an oily mass, weighing three or four tons. The captain sent a drawing of the "killer," which was exhibited. The captain, moreover, said that when he was

second officer of the bark Gem, of Sag Harbor, Captain Ludlow, of that ship, captured a "killer," and carried home his jaw. Captain Daniel McKenzie, too, wrote him that he had seen thousands of "killers," but never saw one taken. He sent on drawings to the lieutenant, sketched from memory, which strikingly corresponded with that of Captain Royes. It was customary, he said, for a shoal of "killers" to attack a right whale, always plunging for the throat. Then others would snatch at his lips, tongue, and other parts about the mouth, the poor fish lying paralyzed with fear meanwhile, until they, fastening upon it, would sink it. Now, the "killer" can stay much longer under water than a right whale—long enough, indeed, to drown the whale.

A friend told him that he once pulled up to a whale so attacked and lanced it. The "killers" thrashed about in the greatest fury—even attacked the boats, and more than once, seizing the fish, carried it under water. The "killer" attacks all kinds of whales, though most often the right whale; he scours the ocean from pole to pole, is in every sea, and all old whalemen have met him.

At a subsequent day a paper was read by Dr. Hamel, of St. Petersburg, describing the "killer," from the journal of a voyage to Russia, made by John Tradescant, in 1618. The account agreed almost exactly with that of Lieutenant Maury.

The animal was said to be four or five feet long, with a stout dorsal fin, and the torment of all whales. These latter animals, he remarked, never floated ashore without their tongues having been eaten out and their lips torn off. These "killers," said Tradescant, make good oil, but yield no whalebone.

ON THE VENOM OF SERPENTS.

There is much in the history and habits of the reptile tribes, however repulsive they may be in appearance, that is very interesting. During a sojourn of two or three months in the interior of Arkansas, which appears to me to be the paradise of reptiles, I paid some attention to that branch of natural history called ophiology. I found four distinct varieties of rattlesnakes, (*crotalus*,) of which the Crotalus Horridus and Crotalus Kirtlandii are by far the most numerous. The former is the largest serpent in North America. The family of moccason snakes (Colluber) is also quite numerous, there being not less than ten varieties, most of which are quite as venomous as the rattlesnake. By dissecting great numbers of different species, I learned that the anatomical structure of the poisoning apparatus is similar in all the different varieties of venomous serpents. It consists of a strong framework of bone, with its appropriate muscles in the upper part of the head, resembling, and being in fact, a pair of jaws, but externally to the jaws proper, and much stronger. To these is attached, by a ginglymoid articulation, one or more movable fangs on each side, just at the verge of the mouth, capable of being erected at pleasure.

These fangs are very hard, sharp, and crooked, like the claws of a cat, and hooked backward with a hollow from the base to near the point. I have occasionally seen a thin slit of bone divide this hollow, making two. At their base is found a small sac, containing two or three drops of venom, which resembles thin honey. The sac is so connected with the cavity of the fang during its erection that a slight upward pressure forces the venom into the fang at its base, and it makes its exit at a small slit or opening near the point with considerable force; thus it is carried to the bottom of any wound made by the fang. Unless the fangs are erected for battle, they lie concealed in the upper part of the mouth, sunk between the external and internal jaw bones, somewhat like a penknife blade shot up in its handle, where they are covered by a fold of membrane, which encloses them like a sheath; this is the *vagina dentis*. There can be no doubt that these fangs are frequently broken off or shed, as the head grows broader, to make room for new ones nearer the verge of the mouth; for, within the vagina dentis of a very large crotalus horridus, I found no less than five fangs on each side—in all stages of formation—the smallest in a half-pulpy or cartilaginous state, the next something harder, the third still more perfect, and so on to the main, well-set, perfect fang. Each of these teeth had a well-defined cavity like the main one. Three fangs on each side were frequently found in copperheads, vipers, and others.

The process of robbing serpents of their venom is easily accomplished by the aid of chloroform, a few drops of which stupefies them. If, while they are under its influence, they are carefully seized by the neck, and the vagina dentis held out of the way by an assistant with a pair of forceps, and the fang be erected and gently pressed upwards, the venom will be seen issuing from the fang and dropping from its point. It may then be absorbed by a bit of sponge, or caught in a vial, or on the point of a lancet. After robbing several serpents in this manner, they were found, after two days, to be as highly charged as ever with venom of equal intensity with that first taken.

During the process of robbing several species of serpents, I inoculated several small but vigorous and perfectly healthy vegetables with the point of a lancet well charged with venom. The next day they were withered and dead, looking as though they had been scathed with lightning. In attempting to preserve a few drops of venom, for future experiments, in a small vial with two or three parts of alcohol, it was found in a short time to have lost its venomous properties. But after mixing the venom with aqua ammonia, or spirits of turpentine, or oil of peppermint, or of cinnamon, or of cloves, or with nitric or sulphuric acid, it still seemed to act with undiminished energy. It is best preserved, however, for future use, by trituration with refined sugar or sugar of milk.

A very fine large cotton-mouth snake, being captured by putting a shoestring around him, became excessively ferocious, striking at even the crack of a small riding whip. Finding himself a prisoner without hope of escape, he turned his deadly weapons on his own body, striking re-

peatedly his well-charged fangs deeply into his flesh. Notwithstanding this, he was put in a small basket and carried forward. In one hour after he was found dead, and no amount of irritation could excite the least indication of life. Four hours after, while removing the skin for preservation, the blood oozed slowly from the vessels in a dissolved state. No violence was done to his snakeship except what he did himself.

Another moccason, shot by a pistol about two inches back of the head, and skinned immediately, gave decided evidence of vitality, four hours after being flayed, by writhing the body whenever it was irritated by a scalpel.

A large rattlesnake, beheaded instantly with a hoe, would, an hour and a half after, strike at any thing that pinched its tail. Of several persons who were testing their firmness of nerve by trying to hold the hand steady while the serpent struck at it, not one could be found whose hand would not recoil in spite of his resolution; and one man, a great bully, by the by, was struck on thenaked throat with considerable force by the headless trunk of the serpent, and staggered back, fainted and fell, from terror. Mr. Stewart, of Mississippi, tells me he once witnessed a similar scene. An old hunter shot a rattlesnake's head off, and, after reloading his gun and standing some time, he stooped to pull off the rattles, and the bloody but headless trunk of the snake struck him in the temple, and he fainted and fell down with terror.

Seven venomous serpents, belonging to five different species, were made to fraternize and dwell amicably in one den. A beautiful pair of long-bodied, speckled snakes, known as king-snakes, found to be fangless, and consequently without venom, were duly installed as members of the family. Some uneasiness was perceivable among the older members; but no attempt was made to destroy the intruders, though they might have been killed instanter. The next morning four of the venomous serpents were found to have been destroyed by the king-snakes, and one was still within their coil, and the two remaining ones would make no effort at self-defence. A large rattlesnake seemed stupid and indifferent to his fate. He could not be made to threaten or give warning even with his rattles. The smallest king-snake was afterwards inoculated with the poison of one of the serpents he had destroyed, and died immediately after—thus evincing that they must have exercised some power besides physical force to overcome their fellow-creatures.

In short, the results of a great number of experiments performed with the venom of a great variety of serpents seem to lead to the following conclusions:—

1. That the venom of all serpents acts as a poison in a similar manner.
2. That the venom of some varieties is far more active than that of others.
3. That a variety of the colluber, known as the cotton-mouth, is the most venomous serpent in Arkansas.
4. That the venom of serpents destroys all forms of organized life, vegetable as well as animal.

5. That alcohol, if brought in contact with the venom, is, to a certain extent, an antidote.

6. That serpents do possess the power of fascinating small animals, and that this power is identical with mesmerism.

7. That the blood of small animals, destroyed by the venom of serpents, bears a close resemblance to that of animals destroyed by lightning or hydrocyanic acid; it loses its power of coagulation, and cannot be long kept from putrefaction.—*Dr. J. Gilman, St. Louis Med. and Surg. Jour.*

ON THE OCCURRENCE OF DEATH AT DIFFERENT DAILY PERIODS.

The hours most fatal to life are thus determined by a writer in the *London Quarterly Review*, from the examination of the facts in 2,880 cases:—

If the deaths of the 2,880 persons had occurred indifferently at any hour during the 24 hours, 120, it might be supposed, would have occurred at each hour. But this was by no means the case. There were two hours in which the proportion was remarkably below this, two *minima* in fact—namely, from midnight to 1 o'clock, when the deaths were 83 per cent. below the average, and from noon to 1 o'clock, when they were 20¾ per cent. below. From 3 to 6 o'clock A. M. inclusive, and from 3 to 7 o'clock P. M., there is a gradual increase, in the former of 23½ per cent. above the average, in the latter of 5½ per cent. The *maximum* of death is from 5 to 6 o'clock A. M., when it is 40 per cent. above the average; the next, during the hour before midnight, when it is 24 per cent. in excess; a third hour of excess is that from 3 to 10 o'clock in the morning, being 18½ per cent. above. From 10 A. M. to 3 P. M. the deaths are less numerous, being 16½ per cent. below the average, the hour before noon being the most fatal. From 3 o'clock P. M. the deaths rise to 5½ per cent. above the average, and then fall from that hour to 11 P. M., averaging 6½ per cent. below the mean. During the hours from 9 to 11 o'clock in the evening, there is a *minimum* of 6½ per cent. below the average. Thus the least mortality is during the mid-day hours—namely, from 10 to 3 o'clock; the greatest during early morning hours, from 3 to 6 o'clock. About one-third of the total deaths were children under five years of age, and they show their influence of the latter more strikingly. At all hours, from 10 o'clock in the morning until midnight, the deaths are at or below the mean; the hours from 4 to 5 P. M. and from 9 to 10 P. M. being *minima*, but the hour after midnight being the lowest *maximum*: at all the hours from 2 to 10 A. M. the deaths are above the mean, attaining their *maximum* at from 5 to 6 o'clock A. M., when it is 45½ per cent. above.

ASTRONOMY AND METEOROLOGY.

NEW PLANETS DISCOVERED DURING THE YEAR 1854.

The number of planetary bodies belonging to the Solar System has been increased during the year 1854 by the discovery of six new asteroids.

The 27th asteroidal planet, discovered by Mr. Hind, of London, on the evening of November 8, 1853, has received the name of Euterpe. The 28th asteroidal planet was discovered on the evening of the 1st of March, 1854, by Mr. Luther, director of the Observatory at Bilk, Germany. This planet has received from Mr. Encke the name of Bellona, and resembles a star of the 10th magnitude.

The 29th asteroid was discovered on the morning of the 2d of March, 1854, at the Regent's Park Observatory, in London, by Mr. Albert Marsh. It also has the appearance of a star of the 10th magnitude, and has received the name of Amphitrite. This planet was discovered independently by M. Chacornac, assistant observer at the Observatory of Paris. He also, on the 4th of February, at Marseilles, noted a star of the 10th magnitude, which is now wanting in that place, and which is shown to have been the body first recognized as a planet by Mr. Marsh.

The 30th asteroid was discovered on the 22d of July, by Mr. Hind, at Mr. Bishop's Observatory, Regent's Park, London. It has the appearance of a star of the 9th–10th magnitude, and has received the name of Urania.

On the night of the 2d of September, Mr. James Ferguson, assistant astronomer of the National Observatory, Washington, discovered the 31st asteroidal planet in the field of the telescope at the same time with the 13th, Egeria. "The priority of this discovery," says Lieut. Maury, in his official report, "belongs to the National Observatory; and this new star is added to the family of asteroids as the first representative of America among them, and a memorial of her zeal in the cause of astronomy. As a testimony of the high approbation in which the talents and the industry of Mr. Ferguson are held, the honor of naming this planet was left to him. Following the rule adopted by astronomers with regard to the asteroids, he has selected the graceful name of Euphrosyne."

On the night of the 20th of October, two additional asteroids were discovered at the Observatory at Paris by MM. Goldschmidt and Chacornac.

The 32d asteroid has received the name of Pomona.

The 33d asteroid has received the name of Polymnia.

COMETS DISCOVERED DURING THE YEAR 1854.

The first comet of 1854 was discovered by M. Meuciaux, near Damazan, in France. It was visible to the naked eyē on the 29th of March and the few succeeding days.

The second comet of 1854 was discovered by M. Klinkerfues, at Göttingen, June 4, 1854.

The third comet of 1854 was discovered by Mr. Robert Van Arsdale, at Newark, N. J., on the 13th of September. It was also discovered on the 11th of September, by M. Klinkerfues, of Göttingen.

ON THE SMALLER PLANETS.

M. Leverrier has recently communicated to the French Academy a memoir upon the smaller planets and their eccentric orbits and their irregularities; wherein, after stopping a moment to explain a phrase in a previous memoir, (which had been misunderstood,) saying that when he assigned as the "superior limit" of the total mass of all the small planets which circulate between Mars and Jupiter a sum not exceeding one-quarter of the mass of this earth, he was far from indicating any, even a probable, equivalent to their mass, which may be inferior, very inferior, to one-fourth of the mass of the earth. He was like a man who wished to weigh a mass of lead, and had a pair of scales, but no weight except a weight of 100 pounds; and the lead being less than a 100 pounds, his weight would enable him to ascertain this, but would not allow him to find by how much it was less than one hundred pounds. So M. Leverrier, when he wished to gauge this planetary mass in his astronomical scales (the orbit of Mars) with the grand axis of the curve as the scales' needle or index, he knew that the scales would not turn unless they were charged with a mass of matter equal to one-quarter of the mass of our globe; the scales did not turn, and he knew the mass of these scattered planets does not equal one-quarter of the mass of our globe, but how much they are less than that he cannot say. After stopping to make this explanation, he communicated to the Academy some new propositions which he has deduced from a complete examination of the secular variations of the elements of the orbits of this group of small planets. All of these orbits are characterized by eccentricities and by considerable inclinations, or, in other terms, that each of these small stars, in its translation movement around the sun, describes an oval and a greatly lengthened curve; that the planes of these several orbits, far from coinciding among themselves, as if traced on the same plane, are greatly inclined to each other. In the present state of

things these eccentricities and these inclinations are totally incompatible with Olbers's hypothesis, which supposed that the small planets (some of which were discovered even in his day) were produced from the wreck of a larger star which had exploded. The forces necessary to launch the fragments of a given body in such different routes, whose existence we should be oblige to suppose, would be of such an improbable intensity that the most limited mathematical knowledge could not but see its absurdity. However, as the mutual actions of the celestial bodies belonging to the same system give rise to perturbations which gradually deform their primitive orbits, M. Leverrier resolved to examine whether the present eccentricities and inclinations of the smaller planets might not owe their origin to perturbing actions, whose effects have been accumulated with time. He soon ascertained that in the annular zone between the orbits of Mars and of Jupiter there are two very distinct regions, so far as respects the bodies placed within them. The line of demarcation between these two regions is distant from the sun the double of that commonly kept by the earth. Beyond this distance the perturbations can permanently increase neither the eccentricity nor the inclination of the stars therein primitively established; within this distance the conditions are changed; there is neither "stability" in the form nor in the inclinations of orbits. Out of the twenty-seven small planets known to us, there is not one of them which invades this dangerous field; the nearest of them all still keeps so respectful a distance as to assure itself an orbit analogous to that it now describes. M. Leverrier concludes his memoir by advancing these propositions, which forever annihilate Olbers's hypothesis. 1st. The eccentricities of the orbits of the known small planets cannot receive from perturbations but very slight changes; these eccentricities (great as they now are) have been, and always will be, great. 2d. The same truth applied to the inclination of the orbits; so that the degree of the inclinations and of the eccentricities is plainly deducible from the primitive conditions of the formation of the group of these smaller planets. 3d. These propositions are true only for distances from the sun superior to 2.00, the distance of the earth being taken as the unity; there would be no "stability" for a small planet situated between Mars and a distance of 2.00. Flora is found at a distance of only 2.20 from the sun, and is the nearest of the smaller planets; are there any within this zone? We cannot tell, because they are never at the same time sufficiently near us and sufficiently disengaged from the solar light.

ON THE RINGS OF SATURN.

Sir David Brewster in a recent publication presents the following curious and startling speculation respecting the rings of Saturn. He says, "According to very recent observations, the ring is divided into *three* separate rings, which, according to the calculations of Mr. Bond, an American astronomer, must be fluid. He is of opinion that the number of rings is

continually changing, and that their maximum number, in the normal condition of the mass, does not exceed *twenty*. According to Mr. Bond, the power which sustains the centre of gravity of the *ring* is not in the planet itself, but in its satellites; and the satellites, though constantly disturbing the ring, actually sustain it in the very act of perturbation. Mr. Otto Struve and Mr. Bond have lately studied, with the great Munich telescope, at the observatory of Pulkowa, the *third* ring of Saturn, which Mr. Lassels and Mr. Bond discovered to be *fluid*. They saw distinctly the dark interval between this fluid ring and the two old ones, and even measured its dimensions; and they perceived at its inner margin an edge feebly illuminated, which they thought might be the commencement of a fourth ring. These astronomers are of opinion that the fluid ring is not of very recent formation, and that it is not subject to rapid change; and they have come to the extraordinary conclusion, that the inner border of the ring has, since the time of Huygens, been gradually approaching to the body of Saturn, and that *we may expect sooner or later, perhaps in some dozen of years, to see the rings united with the body of the planet*."

With this deluge impending, Saturn would scarcely be a very eligible residence for men, whatever it might be for dolphins. But Sir David saves himself by the clause of his proposition, in which he maintains that, if the planets and stars are not already habitable worlds, they are in a state of preparation for the residence of intelligent beings.

ON THE EXISTENCE OF A LUNAR ATMOSPHERE.

The universally accredited theory, that the moon is uninhabited because she has no atmosphere, has received, from a recent discovery, a blow that will unsettle it at least. That the moon, as far as we have yet been able to examine her, has no atmosphere, or at least none of sufficient density to conform to our optical laws and the demands of any animal life known to us, is unquestionable. But this can be positively affirmed of only one side of our satellite; for, as will be remembered, although she revolves upon her axis, she constantly presents but one side to the earth. Now, it has been discovered by calculation, and demonstrated as geometrical fact, that the moon's centre of form is eight miles nearer to us than her centre of gravity, through which, of course, her axis of revolution must pass; or, in other words, *this side of the moon is sixteen miles higher than the other*. If, therefore, we suppose that the moon has an atmosphere such as ours, it would be of such extreme rarity on the only side exposed to our observation, that, for optical effect and animal life, it might as well not exist; for mountains upon the earth, none of which are over five miles above the level of the sea, have been ascended to a height at which life could not be supported for any length of time, and still mountains have stretched above the panting traveller. What, then, must be the atmosphere at four times such an elevation? The conclusion seems inevitable, that, although the hither side of the moon is uninhabita-

ble for want of an atmosphere, the remote side may be perfectly adapted to animal life. It is at least certain that the mere want of an atmosphere perceptible to us is no longer conclusive as to the uninhabitableness of the planet that rules the night. We announce this discovery on the authority of one of the most eminent mathematicians and astronomers in the world.—*The above is given by the N. Y. Courier and Enquirer, on the authority (it is understood) of Prof. Pierce, of Harvard.*

ON THE OCCURRENCE OF HAIL STORMS IN THE ISLAND OF CUBA.

At the last meeting of the American Association, M. Andres Poey, of Havana, Cuba, presented a paper containing some interesting observations on the occurrence of hail in the West Indies, especially in Cuba, and the apparent increase of this phenomena during the last few years.

Until within a comparatively recent period, the occurrence of hail in some of the islands was considered an extraordinary event. Humboldt, as the result of his observations, came to the conclusion that, at Havana, hail occurred at intervals of 15 or 20 years. M. Poey, in examining the subject, found that the records for a considerable time previous to Humboldt's visit to Cuba, and for some time after, confirmed the truth of his assertions; but within the last few years hail has become "frequent phenomena." Thus M. Poey states that from 1828 to 1846 there was no hail at Havana, but from 1846 to 1850 hail occurred each year. In 1850 there was no hail, but the phenomena occurred in 1851, '52, '53 and '54.

The conclusions at which M. Poey has arrived are, that for some reason the phenomena of hail has increased and become frequent during the last few years in the Island of Cuba, and that the maximum of hail does not occur, as might be expected, in the hottest months, but in March and April.

GEOGRAPHY AND ANTIQUITIES.

ANCIENT BABYLON.

It may be known to many of our readers that the French government has employed a party of gentlemen to explore the site of ancient Babylon. From reports just received from them, it appears that they have ascertained, beyond reasonable doubt, that the ruins beneath a tumulus called the Kasr are those of the marvellous palace-citadel of Semiramis and Nebuchadnezzar. They are in such a state of confusion and decay that it is impossible to form from them any idea of the extent or character of the edifice. They appear, however, to extend beneath the bed of the Euphrates—a circumstance accounted for by the change in the course of that river. In them have been found sarcophagi of clumsy execution and strange form, and so small that the bodies of the dead must have been packed up in them—the chin touching the knees, and the arms being pressed on the breast by the legs. These sarcophagi have every appearance of having been used for the lowest class of society; but notwithstanding the place in which they were found, the discoverers are inclined to think that they are of Parthian, not Chaldean, origin. There have also been found numerous fragments of enamelled bricks, containing portions of the figures of men and animals, together with cuneiform inscriptions—the latter white in color, on a blue ground. According to M. Fresnel, the chief of the expedition, these bricks afford a strong proof that the ruins are those of the palace of Nebuchadnezzar, inasmuch as the ornaments on them appear to be sporting subjects, such as are described by Ctesias and Diodorus. The foundations having been dug down to in certain parts, it has been ascertained that they are formed of bricks about a foot square, united by strong cement, and that they are in blocks, as if they had been sapped in all directions. In a tumulus called Amran, to the south of Kasr, interesting discoveries have also been made. They appear to be the ruins of the dependencies of the palace situated on the left bank of the Euphrates; and they contain numerous sarcophagi, in which were found skeletons clothed in a sort of armor, and wearing crowns of gold on their heads. When touched, the skeletons, with the exception of some parts of the skulls, fell into dust; but the iron, though rusty, and the

gold of the crowns, are in a fair state of preservation. M. Fresnel thinks that the dead in the sarcophagi were some of the soldiers of Alexander or Seleucus. The crowns are simple bands, with three leaves in the shape of laurel on one side, and three on the other. The leaves are very neatly executed. Beneath the bands are leaves of gold, which it is supposed covered the eyes. From the quantity of iron found in some of the coffins, it appears that the bodies were entirely enveloped in it; and in one there is no iron, but some earrings—a proof that it was occupied by a female. The sarcophagi are about two and three-quarter yards in length by between half and three-quarters of a yard wide, and are entirely formed of bricks united by mortar. In addition to all this, a tomb, containing statuettes, in marble or alabaster, of Juno, Venus, and of a reclining figure wearing a Phrygian cap, together with some rings, earrings, and other articles of jewelry, has been found, as have also numerous statuettes, vases, vials, articles of pottery, black stones, &c., of Greek, Persian, or Chaldean workmanship.

LIVINGSTON'S RESEARCHES IN SOUTH AFRICA.

Dr. Livingston, the well-known English missionary, has recently accomplished one of the most remarkable journeys ever undertaken; viz., that from the Cape of Good Hope, through Central Africa, to the Portuguese settlement of Loanda, on the West Coast. His plan of proceeding differed materially from any of his predecessors; instead of setting out with half a hundred attendants, horses, bullock wagons, &c., he commenced his journey, carrying with him only a sextant, gun, chronometer, tent, four servants, and as many days' provisions, relying on Providence and his gun for a supply when these were gone. After leaving the Cape Colony, he was obliged to travel a long way to the N. E., to avoid the deserts and hostile tribes in their vicinity that lay on his left; crossing in this route a great many branches of the River Zambegi and others, the names of which I have forgotten, till he arrived at a large town; there, as the chief was very hospitable, he remained a short time to recruit his health, having been nearly drowned and starved half a dozen times during the nine months it took him to perform this part of his journey, and his arm badly broken in two places by a lion. It appeared he had wandered one evening from his attendants, after they had pitched their tent, in quest of game, when he came suddenly on a large lion crouching down ready for a spring at him; without waiting a second, he fired, and must have been knocked down at the same moment and stunned, as he remembers nothing from the time he fired till he was found by his servants next morning: when they came up they found the doctor insensible, and the lion lying dead alongside him. When he left, the chief, who was very desirous of finding a route to the westward for the transmission of his ivory, gave him twenty-four of his people to assist him on his journey. After leaving,

he again travelled to the N. E., until he arrived in the parallel of Loanda. Now came the tug of war; he had upwards of a thousand miles to travel across the unexplored countries of our charts — a tract never hitherto trodden by any white man, and wholly unknown even to the blacks he had seen as yet. However, this part of their journey proved to be the easiest; and it was not till he arrived near Cassanga, on the Portuguese frontier, that he met with any molestation. The country he found to be thickly populated, and the inhabitants very peaceably disposed. From their never having seen a white man before, you may fancy what an object of curiosity he became to them; wherever he stopped, the people from far and near flocked round him with the utmost astonishment pictured on their countenances. As the doctor was very much sunburnt, his color did not so much surprise them as his hair, which was very long; this was the great object of attraction wherever he went, and highly favored did those fancy themselves who became the possessors of a lock of it. Every tribe he met with had some idea of one supreme Being and a future state of existence, though they all worship in addition various animals that they hold sacred. At every place he stopped they supplied him liberally with provisions, and it was not (as I mentioned before) till he arrived near the Portuguese territories that he met with any trouble. There the inhabitants have been in the habit of kidnapping the people farther inland, to sell to the Portuguese for slaves; and fearing should a road be opened that way it would spoil their traffic, they became very troublesome, and wanted the doctor to pay toll nearly every step he took. However, by putting on a bold front, he managed to make his way through, and arrived at Loanda safely in the beginning of June, making it exactly two years since he left the Cape.

CURIOUS ANTIQUARIAN DISCOVERIES AT CANOSA.

During the past year, some of the most remarkable antiquarian discoveries of recent date have been revealed at Canosa, a small village of Southern Italy. This place is the site of one of the most celebrated ancient Greek cities in Puglia, and is the only one in the whole kingdom which offers the wonderful contrast of a Greek Pompeii to our Roman Pompeii. It is situated on a rising ground, in the centre of a plain which is surrounded by a semicircle of low hills. Between these and the modern city the plain encloses for many miles of circumference the old Necropolis, or city of the dead. At every step, on digging three or four feet under ground, we meet with an old path, which conducts by a descent to a tomb composed of one or more chambers, and which is surrounded on the outside by other funereal apartments. Their "facciate" are decorated with columns and frontispieces, and are painted with lively colors; their gates are so well closed by vertical pieces of tufa that the soil has not been able to penetrate them. We enter, therefore, these habitations of the dead as we walk into the houses of the living. The light of the sun shines in

upon them as it did twenty centuries since, and, in the very middle of the first chamber, reveals one or more skeletons fully clothed, with their arms or precious ornaments. Around them stand painted vases, furniture of every form, utensils of various kinds and metals, precisely in the spots where their relatives or dearest friends had placed them. The walls are adorned with elegant pictures, with friezes bearing the figures of warriors who combat, and with decorations of an original style hitherto unknown. It creates a very natural surprise that scarcely one in a hundred of these tombs has been examined in past times, and that, even when this has been the case, objects of art in gold, glass, ivory, and vases have not been removed. It would seem as if money had been the only object of search. In some streets the tombs are evidently for the most part those of the poor; in others they are the last habitations of people in easier circumstances; and in some are found the mausoleums of rich and powerful citizens. The antique articles which are found in these various classes of sepulchres and people are likewise of a different and distinct character. Amongst the tombs, too, of those who were poor, sometimes is found a noble and richly-adorned sepulchre, an instance of which is one which was discovered in 1813. At present we are indebted for the encouragement of the arts to His Majesty of the Two Sicilies, for a renewal of excavations which have been so long suspended—and hitherto the works, which have been conducted with his usual ability by Cavalier Bonucci, have rendered an ample harvest. They were commenced at the beginning of this year; and though the severity of the winter, which has covered Puglia with frost and snow, has thus much retarded the works, yet some rare sepulchres have been discovered, remarkable for their novel and beautiful architecture and their curious monuments. Amongst these, a tomb opened to the north of Canosa cannot fail to awaken the wonder of all Europe. It lies near the ancient gate of Canosa, at a short distance from the River Ganto. This tomb is composed of two subterranean chambers, formed in the hard mass of the earth, and belongs to a warrior, who still wears his arms of bronze and of iron. Along the sides of the walls were found a quantity of large and small pateræ, tazze, and ordinary drinking vessels. In the midst of these stood six vases, which formed three equal pairs, of a size perfectly wonderful. On these are represented very rare and precious subjects—as the Rape of Europa, the Vengeance of Medea, the Liberation of Andromeda, and the Funeral Pyre of Patroclus, round which the body of Hector is being dragged by the car of Achilles. But there is one vase which by the size and the subjects of its paintings will form an epoch in the annals of archæology and the arts, and by its historic interest, perfectly unique in monumental vases, is calculated to awaken the wonder of modern times. It is a vase whose paintings represent Greece and Asia, and in the midst of them the Genius of Discord, who raises aloft the flaming torch. Darius is seated amidst his satraps, and Persia, personified, addresses to them a grave and sorrowful speech. Besides these there are various graceful figures of women, whose heads

are covered with the Phrygian tiara, and who represent, perhaps, the various kingdoms of Asia offering to an eminent personage their rich tributes to support that bloody war. All the principal figures have their corresponding appellations affixed.

MEMORIALS OF THE ANCIENT ANGLO-SAXONS.

The most valuable collection that has ever been formed of pagan Saxondom is that of the late Rev. Bryan Faussett, now in the possession of Mr. Mayer, of Liverpool. It imbodies the contents of from seven to eight hundred graves, and they throw a remarkable light upon the history of that age. At the close of the late meeting of the British Association at Liverpool, Mr. Mayer exhibited the Faussett Anglo-Saxon relics at a very crowded *soirée* given to the members of the Association; and a descriptive lecture explanatory of this collection, which of late years has attracted great attention in England, was given by Mr. Thomas Wright.

The Rev. Bryan Faussett, of Heppington, near Canterbury, to whom we owe the formation of this collection, had passed the greater part of his life in a district peculiarly rich in Saxon remains; for the succession of chalk downs stretching out from Canterbury towards the east and south are remarkable for the numerous groups of Saxon barrows, or rather the Saxon cemeteries, which are found on their slopes and summits. His attention having been somewhat accidentally drawn to the subject, he commenced their investigation, and pursued it unremittingly from the year 1757 to 1773, during which time the articles were collected from the different tombs or barrows.

In describing the collection, Mr. Wright expressed his entire belief in the pagan character of the relics, and gives the following interesting description of their particulars and mode of arrangement in the graves :—

"The body was usually laid on its back in the middle of the floor of the grave. In the MS. account of his diggings, Faussett frequently mentioned traces of the existence of a coffin; but, as far as my own experience goes, I am led to think that the use of a coffin was not common. Where the body was that of a man, we almost always find above the right shoulder the iron head of a spear; and in general we may trace by the color of the earth the decayed wood of the shaft, until near the foot of the skeleton lies the iron-spiked ferrule which terminated it at the other end. We sometimes also meet with one or more smaller heads of javelins, or arrows; for I disagree entirely with a statement which has been made lately and adhered to, that the bow was in discredit among the Anglo-Saxons as a weapon. Closer to the side of the skeleton lies usually (though not always) a long iron broad-sword, not much unlike the claymore of the Scottish Highlander, of which it is probably the prototype. The sheath and handle appear in most cases to have been made of perishable materials, and we seldom find more than the blade with the spike by which it was

fixed into the handle. The tip of the sheath, however, is sometimes found having been made of bronze or other metal, and also, at times, the handle of the sword, which has been found of silver. Another article, peculiarly characteristic of the Saxon interments, is the knife, the length of which is generally about five or six inches, although at times it extends to from ten to eleven inches; and then from its shape it must have been a very formidable weapon, independent of its utility for other purposes. It has been pretended that it was from the use of this instrument, called in their language a *seax*, that our forefathers derived their name of *Saxons*. Another weapon, the axe, is found at times in the Saxon graves, but it is of very rare occurrence, and was probably not in general use in this island.

"Over the breast of the Saxon warrior is generally found the iron umbo or boss of his shield. Beneath the boss of the shield is usually found a piece of iron, which is best described by a drawing, and which, no doubt, was the handle by which the shield was held. Douglas, who had not observed carefully the position in which it is found, imagined it to be part of a bow, and called it a bow-brace. The shield itself, as we know from the Anglo-Saxon writers, was of wood, generally of linden, and has, therefore, perished; but we find remains of nails, studs, and other iron work belonging to it.

"Such are the more common arms which we find, without much variation, in the graves of our Anglo-Saxon forefathers of the period to which these cemeteries belong. The miscellaneous articles are so varied that I can only enumerate them rapidly. Of personal ornaments, the first that attract our attention are the fibulæ, or brooches, and the buckles. The latter are usually of bronze gilt, and are often very elaborately ornamented. From the position in which they are found, it is evident that they formed, most generally, the fastening of the girdle. They are sometimes very massive, the larger ones apparently belonging to the male, and the smaller ones to the female, costume.

"Many of the fibulæ which are found upon male skeletons, as well as females, are extremely rich and beautiful. In the Kentish tumuli the prevailing form is circular, and they are often of gold, profusely ornamented with filigree work, and with garnets or other stones, or sometimes glass or paste, set usually upon checkered foils of gold. The use of this fibula appears to have been to fasten the mantle over the breast, where it is most commonly found. Their general size is from an inch and a half to two inches in diameter; but the Faussett collection possesses one of considerably larger dimensions, which was found in the grave of an Anglo-Saxon lady on Kingston Down. This magnificent ornament is no less than three inches and a half in diameter, a quarter of an inch thick at the edges, and three-quarters of an inch thick at the centre, all of gold, and weighing between six and seven ounces. It is covered with ornaments of filigree work, in concentric circles, and is set with garnets and with pale-blue stones. The acus, or pin, on the back is also ornamented and set with garnets. It was found high on the breast, near the right shoulder. Other

examples of the eircular gold fibula will be seen in the Faussett collection, and they are met with in almost every collection of Anglo-Saxon remains from the Kentish barrows.

"Other jewelry, such as rings, bracelets, necklaces of beads, pendants to the neck and ears, &c., are found in abundance, and in a great variety of form. Gold coins are sometimes fitted up as pendent ornaments. The most common material of beads is glass or variegated clay, the latter made with great skill, and often exhibiting pleasing patterns. It belonged to a class of manufacture which has continued to exist in this country down to a recent period. Another common material of beads was amber; and we sometimes find small lumps of amber which have been perforated, in order to be attached to the person by a string. It must be observed that we sometimes find a string of beads round the neek of a man; and other circumstances show that there were Saxon *exquisites* who were vain enough of their personal adornments. It is, however, a very usual thing to find one or more beads of amber near the neck in cases where there can be no doubt that the deceased was a man; but this circumstance is explained by a widely-prevailing superstition in the middle ages, that amber carried on the person was a protection against the influence of evil spirits. Large hairpins, usually of bone or bronze, and more or less ornamented, are generally found near the heads of skeletons of females, in such a position as leads us to conelude that the Saxon ladies bound up their hair behind in a manner similar to that which prevailed among the Romans.

"A great variety of household utensils, of different kinds, are also found in the Anglo-Saxon graves. The pottery, when not Roman, is of a rude construction, and, in fact, it is not very abundant; for our Anglo-Saxon forefathers, for several ages after their settlement in this island, seem to have used principally pottery of Roman manufacture. I would merely call your attention to the particular character of several earthen ware urns found in Kent, which Bryan Faussett supposed to be early Romano-British, and of which I shall have to speak again farther on. But if the Anglo-Saxon earthen ware was rude and eoarse in its character, the case was quite different with the Anglo-Saxon glass, which is rather common in the graves of Kent. The glass of the Anglo-Saxons is fine and delicately thin. It is found chiefly in drinking cups, though a few small basins and bottle-shaped vessels of glass have been found. The form of the drinking cups will be best understood by a diagram. It will be observed that they are either pointed at the bottom, or rounded in such a manner that they could never have stood upright—a form which it is supposed was given them to force each drinker to empty his glass at a draught. This practiee is understood to have existed down to a much later period, and it is said to have given rise to the name *tumbler*, applied originally to a drinking glass which was never intended to stand upright. The ornamentation of the Anglo-Saxon glass generally consists either of furrows, on the surface, or of strings of glass attached to the vessel after it was made. Both these ornaments seem to come fairly under the epithet

'twisted,' which is often applied to drinking cups in the earliest Anglo-Saxon poetry that has been preserved.

"Bowls, large basins, and dishes are not unfrequently found in these graves, of such elegant form that we can hardly help supposing them to be of Roman manufacture; and in one instance a bowl of apparently Roman workmanship was found mended with what were as evidently Saxon materials. Others, however, seem to be Saxon, and prove certainly that the Anglo-Saxons had skilful workmen. These bowls, basins, and dishes are usually of bronze, often very thickly and well gilt. The metal is generally thin; and it may be remarked, as a particular character which distinguishes Anglo-Saxon workmanship from Roman, that the substance is generally thin instead of being massive. The Anglo-Saxon scissors of this early period resemble in form the shears of modern times, though we have found one or two examples of scissors formed like those now in use. We have also pins, and needles, and keys, and other small articles.

PATENTS.

PATENTS, DESIGNS, RE-ISSUES AND ADDITIONAL IMPROVEMENTS, ISSUED BY THE PATENT OFFICE OF THE UNITED STATES DURING THE YEAR 1854.

Patents,	1,679
Designs,	66
Re-issues,	32
Additional Improvements,	10
Total,	1,787

OBITUARY

OF PERSONS EMINENT IN SCIENCE. 1854.

Arthur Aiken, Secretary of the Royal (English) Geographical Society.
Dr. Barth, the distinguished African traveller.
M. Baumgarde, a French mineralogist, accidentally killed by falling down a mine.
Beautems Beaupre, an eminent French hydrographer.
Dr. Golding Bird, the eminent English pathologist.
M. Bischoff, the German botanist and anatomist.
M. Brockenden, a leading member of the Royal (English) Society.
Dr. W. J. Burnett, of Boston, an eminent American physiologist and naturalist.
F. Catherwood, a distinguished American artist and traveller. He first visited, with J. L. Stephens, the ruined cities of Central America. Lost in the Arctic.
Prof. Craig, an English geologist.
William Darby, of Washington, D. C., a geographer of repute.
Frederic W. Davis, chemist and geologist.
Sir Henry M. Elliot, a distinguished Oriental scholar and traveller.
William P. Elliot, Washington, D. C., architect of the Patent Office, &c.
Charles Euderlin, an eminent German chemist, died in New York.

Dr. Fischer de Waldheim, of Moscow, a distinguished Russian naturalist, director of the Botanic Gardens of St. Petersburg.

Prof. Edward Forbes, Professor in the University of Edinburgh, and distinguished as a naturalist and geologist.

John Facton, an eminent English mechanician and astronomer.

M. Gaudichaud, an eminent French botanist.

Dr. Heernaunsen, a German naturalist, author of the "Index Generum Malacozoorum."

Sir Robert Heron, an English naturalist.

M. Hericourt, French Consul at Djeddah, noted for his travels in Abyssinia and other parts of Africa.

Josiah Holbrook, Washington, D. C.

Prof. Jameson, Editor Edinburgh Philosophical Journal, Professor in the University of Edinburgh.

Prof. Johnson, Professor of Chemistry, Philadelphia.

Col. Laudmann, an English military engineer of repute.

M. Lallemand, an eminent European cultivator of medico-chirurgical science.

Baron de Lindeneau, a distinguished astronomer of Saxony.

Dr. Landsborough, a Scotch naturalist.

Cardinal Mai, the celebrated Italian linguist and philologist.

Capt. Mauby, the well-known inventor of the apparatus for saving life in shipwreck.

Cap. Baron Maurice, an eminent Swiss engineer.

M. Mauvais, a French astronomer.

M. Melloni, the great Italian physicist.

M. Mirbel, a French savan attached to the Jardin des Plantes.

M. Stephano Moricand, a Swiss naturalist.

Robert Newell, inventor of the Parautoptic lock, known as "Hobbs's lock."

George Newport, a very distinguished English naturalist.

Theodore Oliviet, an eminent French physicist.

Dr. Henry S. Patterson, of Philadelphia, author of the "Types of Mankind."

Robert M. Patterson, President of the American Philosophical Society and Academy of Natural Sciences, Philadelphia.

Prof. A. C. Petersen, Superintendent of the Observatory of Altona, and successor of Schumacher as Editor of the Astrononische Nachrichten.

Thare Pete, an eminent Swedish cultivator of science, associate of Berzelius.

Dr. Reub, Professor of the University of Utrecht, a Dutch astronomer.

Admiral Roussin, an eminent French navigator, member of the French Academy.

Prof. Von Schelling, of Berlin.

Dr. Schattuck, Boston, member of the American Academy.

Mr. Sowerby, the well-known English conchologist.

Dr. Stanger, an English naturalist, attached to the Niger Expedition of 1841.

John E. Stocks, a British botanist.

Charles Stokes, an English naturalist.

Dr. Jose Bargas, Professor of Chemistry, University of Caraccas, and Ex-President of the Republic of Venezuela, S. A.

Nathaniel Wallich, Vice President of the Linnæan Society, England.

P. B. Webb, an English botanist.

LIST OF BOOKS, PAMPHLETS, &c.,

ON MATTERS PERTAINING TO SCIENCE, PUBLISHED IN THE UNITED STATES DURING THE YEAR 1854.

MECHANICS AND PHYSICS.

Fairbairn. On the application of cast and wrought iron to building purposes. Wiley N. Y.
Henck. Field book of Engineers. Appleton, N. Y.
Johnson, (William.) The practical draughtsman, or book of industrial design, from the French of Armengaud and Armoreux. Stringer & Townsend, N. Y.
Silliman, Jr., and Goodrich, Editors, Science and Mechanism, illustrated by examples in the New York Crystal Palace. Putnam, N. Y.
Turnbull, Dr. L. Railway accidents prevented by the use of the electro-magnetic safety apparatus. Parry & McMillan, Philadelphia.
Wethered. On Steam.

CHEMISTRY.

Fryatt, (H. N.) Agriculture, its essentials and non-essentials, including an examination of guanos and other manures. Magagnos, N. Y.
Johnson, (J. F.,) F. R. S. Chemistry of common life. Appleton, N. Y.
Waring, S. E., Jr. Elements of Agriculture. Appleton, N. Y.

GEOLOGY.

Dana's Mineralogy, 4th edition. Putnam, N. Y.
Taylor. Statistics of Coal, revised by S. S. Huldeman. Moore, Philadelphia.
Trask, (Dr. J. B.) Report on the Coast Range, and a part of the Sierra Nevada of California, embracing their industrial resources in agriculture and mining. San Francisco, Pub. Doc.
Whitney, (J. D.) Metallic Wealth of the U. S., described and compared with that of other Countries. Lippincott & Co., Philadelphia.
Whitney, Hill & Stevens, Geological Map of Keweenaw Point, Lake Superior.

ASTRONOMY AND METEOROLOGY.

American Almanac, 1855. Phillips & Sampson, Boston.
Barnett. Outlines of a mechanical theory of storms. Appleton, N. Y.
Brewster, (Sir David.) More worlds than one. Carter, N. Y.
Plurality of Worlds, with introduction by Hitchcock. Gould & Lincoln, Boston.

BOTANY AND ZOOLOGY.*

Allen, (J. F.) *Victoria Regia*, with an account of its discovery, introduction and cultivation. Salem.
Bushan. Principles of animal and vegetable physiology. Lea & Blanchard, Philadelphia.
Barrett, (Dr. W. J.) Comparative Anatomy of the Invertebrata, translated from Siebold, with notes. Gould & Lincoln, Boston.
Carpenter. Principles of Common Physiology. Lea & Blanchard, Philadelphia.
Cassin. Birds of California, Texas, Oregon, and British America. Lippincott, Philadelphia.
Dowler, (Dr. Bennet,) Tableaux, Sanatory, Geographical and Geological, of New Orleans.
Fry, (W. H.) Treatise on California Fish Breeding. Appletons, N. Y.
Gray, (Asa.) Botany of United States Exploring Expedition, Vol. I. Phanerogamia.
Hooker, (Dr. Worthington.) Principles of Human Physiology. Bruce & Co., N. Y.
Note and Gliddon. Types of Mankind, with contributions from Agassiz, Usher and Patterson. Lippincott, Philadelphia.
Owen, (Prof.) Principal forms of the skeleton and teeth. Lea & Blanchard, Philadelphia.
Proc. Acad. Nat. Sciences. Philadelphia, Vol. VII. No. IV.
" Nat. His. Soc. Boston.
Storer, (D. H.) Fishes of Massachusetts.
Smithsonian Contributions to Knowledge, Vol. VI.

MISCELLANEOUS.

Beale & Heap. The Central Route to the Pacific; Journal of an expedition from Missouri to California in 1853.
Foulke. Discourse in commemoration of the founding of the Acad. Nat. Sciences at Philadelphia.
Johnson, (E. F.) The Northern Railroad route to the Pacific, its general character, relative merits, &c.
Jemini on the Art of War, translated by Winship & McLean. Putnam, N. Y.
Journal of the United States Agricultural Society. Boston, 1854.
Marcy and McClelland. Exploration of the Red River of Louisiana. Pub. Doc.
Miller, Hugh. The ten records, mosaic and geological. Gould & Lincoln, Boston.
Maury's Sailing Directions, 6th Edition.
Sixty-seventh Annual Report of the Regents of the University of the State of New York.
Seventh Annual Report on the State Cabinet of N. J.
Wells, (David A.) Annual of Scientific Discovery, 1854. Gould & Lincoln, Boston.
Whewell, (William, D. D.) Influence of the history of science upon intellectual education. Gould & Lincoln, Boston.

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LITERARY AND SCIENTIFIC WORKS

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